PREDICTING RELIABILITY AND MAINTAINABILITY FACTORS FOR AIRCRAFT SUBSYSTEMS DURING THE CONCEPTUAL PHASE OF AIRCRAFT DESIGN

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In the past thirty years, reliability and maintainability have become a growing part of system design. This is due in part to the knowledge imparted by the problems incurred on the first generation of complex jet aircraft. Many lessons were learned from the first generation aircraft that are now incorporated in modern aircraft design. Today's environment of budget cuts and constraints also requires reliability to be built into an aircraft design in the conceptual stage of design. For space systems, it is imperative that reliability be built into the design in the very early stages and considered throughout the design process. This case study used aircraft design and performance characteristics (independent variables) and reliability and maintainability parameters (dependent variables) in multiple regression analysis to develop parametric equations that predict reliability and maintainability factors for aircraft subsystems. The subsystems analyzed were landing gear and engines.

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ABSTRACT

PREDICTING RELIABILITY AND MAINTAINABILITY FACTORS FOR AIRCRAFT SUBSYSTEMS DURING THE CONCEPTUAL PHASE OF AIRCRAFT DESIGN.

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University of Dayton, 1997

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In the past thirty years, reliability and maintainability have become a growing part of system design. This is due in part to the knowledge imparted by the problems incurred on the first generation of complex jet aircraft. Many lessons were learned from the first generation aircraft that are now incorporated in modern aircraft design. Today's environment of budget cuts and constraints also requires reliability to be built into an aircraft design in the conceptual stage of design. For space systems, it is imperative that reliability be built into the design in the very early stages and considered throughout the design process.

This case study used aircraft design and performance characteristics (independent variables) and reliability and maintainability parameters (dependent variables) in multiple regression analysis to develop parametric equations that predict reliability and maintainability factors for aircraft subsystems. The resulting equations will be incorporated into a software package that is used to estimate operational capabilities and support requirements in the conceptual design phase of proposed space systems.

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PREFACE

The University of Dayton is under contract from the National Aeronautics and Space Administration to develop, maintain, and upgrade software that develops models that predict reliability and maintainability factors in the conceptual design phase of space system. The model uses parametric equations developed using multiple regression analysis of military aircraft design and performance characteristics as well as reliability and maintainability data. This study was in response to a requirement to update the parametric equations and also add several more predicted reliability and maintainability factors to the models.

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LIST OF ABBREVIATIONS

AIAA	American Institute of Aeronautics and Astronautics
AVGCREW	Average Crew Size
CL	Centerline
EXP	Exponential
FSD	Full-Scale Development
IEEE	Institute of Electrical & Electronics Engineers
lbs t	Pound Thrust
lbs/lbs st	Pounds per Pounds Static Thrust
LCC	Life Cycle Cost
LDNG	Landing
LN	Natural Logarithm
LOG	Logarithm
MIL-STD	Military Standard
MH/MA	Manhours per Maintenance Action
MTBMOp	Mean Time Between Maintenance, Operating Time
MTBMS	Mean Time Between Maintenance, Sortie
MTTR	Mean Time to Repair
NAECON	National Aerospace and Electronics Conference
NASA	National Aeronautics and Space Administration
R&M	Reliability and Maintainability
REMIS	Reliability and Maintainability Information System
SAE	Society of Automotive Engineers
SHP	Shaft Horsepower
SL/ISA	Sea Lever/International Standard Atmosphere
SMH/FLYHR	Scheduled Manhours per Flying Hour
SQ	Square
SQRT	Square Root
TO	Takeoff
USAF	United States Air Force
WUC	Work Unit Code

CHAPTER 1

INTRODUCTION

This report demonstrates the use of parametric regression analysis of aircraft design and performance characteristics (independent variables) to generate equations that predict reliability of aircraft subsystems in the conceptual phase of design. Of the many different subsystems in an aircraft, this report is limited to equations useful in predicting the reliability of the landing gear and engine systems. A list of independent (driver) variables, ranging from number of landing gear wheels to number of pressurized compartments, for twenty-one different United States Air Force (USAF) aircraft, has been collected. Aircraft and subsystem parameters, such as weight and dimensions, also have been collected for use in the regression analysis. The dependent variables were computed using reliability and maintainability (R&M) parameters obtained for the landing gear and engines of the twenty-one aircraft. The independent and dependent variables were input into a statistical software package that performed multiple regression analysis and provided the coefficients necessary to develop the predicting equations.

RESEARCH OBJECTIVE

The goal of this study was to develop accurate R&M prediction models which can be used during conceptual design of new weapon systems. The focus is on predicting landing gear and engine reliability.

BACKGROUND

The prediction of reliability for new aircraft or aircraft subsystems is an important field of study. Predicting the reliability of an aircraft or aircraft subsystem can assist the designers in forecasting the number of spares needed, the size and expertise level of the maintenance crews, costs associated with repair parts, spares storage, tools, down time and warranty. Predicting reliability can be used to forecast the life-cycle-cost (LCC) of an aircraft or aircraft subsystem. Forecasting LCC will allow the designers to see if they are meeting customer requirements and how their design compares against the competition's. LCC can also assist the customer in comparing competing designs against each other and against the customer's predetermined specifications to determine the design that best meets the requirements at the most reasonable cost. Once the customer chooses an aircraft or aircraft subsystem they can establish spares and crew training requirements using the predicted data.

It has been argued "that an accurate prediction of reliability implies such knowledge of the causes of failure that they could be eliminated" (O'Connor, p110). This is not true for two reasons. First, if one attempts to build an aircraft by attempting to design all aspects to be 100 percent reliable, the aircraft will continuously be in the design phase. Second, reliability prediction is not very accurate. Reliability factors are for use in determining design trade-offs rather than producing perfect components. For example, the predicted

reliability of a landing gear system may require the designers to lengthen the shock strut, which may decrease the number of maintenance actions but increase the manhours needed to complete maintenance actions or, a specific jet engine may be reliable enough to justify not having a two engine design, and having a single engine may decrease support costs.

In today's environment of budget constraints, the importance of predicting reliability is essential in designing to meet the customer's cost and mission requirement. Designers must show the customer how they build reliability into their design.

LIMITATIONS AND SCOPE

Many different data sources were used to obtain the independent variables. In most cases, several data sources were used to complete a data set. Some data sets, such as the Oleo data, were obtained from a single source. The majority of the data obtained was verified using several sources to assure correctness. If multiple sources gave different information, the most common point (mode) was used. If data for several configurations of an aircraft were available, the most common configuration in the Air Force inventory was used. Several aircraft do not have complete data sets because the missing independent variable may not have been applicable to the aircraft or the data was not available. The use of many sources may produce inherent errors in the correctness of the data. The dependent variables were computed with R&M data obtained from the REMIS database. The limited time frame that the data was available for caused some gaps in data. Not all aircraft were listed in every time frame and several aircraft had missing data, which caused one of the dependent variables to have a small number of data points available for statistical analysis. This study was also limited to USAF aircraft. This was done to ensure

that all the aircraft were operated in similar environments and missions. The use of Naval aircraft might have produced outliers that would have decreased the accuracy of the equations. This was based on the assumption that Naval aircraft operate in a harsher environment of salty air and carrier decks that affect R&M differently than the environment USAF aircraft operate under. The regression analysis for this study is limited to landing gear and engines. All engines are air breathing. All the independent variable data sets selected from the main data base for the regression analysis relate to the R&M of landing gear and engine systems.

CHAPTER 2

LITERATURE REVIEW

While there have been several significant life cycle costing (LCC) studies which relate parametrically aircraft design and performance characteristics to system and subsystem costs, there are relatively few similar efforts to predict aircraft reliability and maintainability. Two such studies are discussed below.

In the past, LCC studies for new aircraft in development were completed in the final stages of the design phase. This was done in preparation for the aircraft delivery to the customer. Under tighter budgets, customers began requiring designers to build reliability into the design of an aircraft from the conceptual stage of design, well before LCC studies are done. Some early work was done by Kolarik, Davenport, Fant, and McCoun, Texas Tech University, Lubbock in the paper *Early Design Phase Life Cycle Reliability Modeling*. This paper developed a model that allowed the designer to evaluate the reliability characteristics of a system in the early design stages. Work for the National Aeronautics and Space Administration (NASA) was done to develop models for prediction of reliability for reusable launch vehicles. It is obvious that reliable systems are paramount in a space environment; therefore, reliability must be designed into the vehicle in the conceptual stage. Studies on the Space Shuttle Orbiter have been conducted to develop models that might be used for reusable launch vehicles. Early work accomplished

by Ebeling in *Parametric Estimation of R&M Parameters During the Conceptual Design Of Space Vehicle* used multiple regression analysis to develop equations to predict reliability factors. Ebeling's report led to his development, for NASA, of a software package that predicts reliability factors using the methods described in his report. His report also provided the methodology for this report.

Several books from the American Institute of Aeronautics and Astronautics, Education Series, were used to gain knowledge on what independent variables to select for this report.

CHAPTER 3

DATA COLLECTION

The following describes, in detail, all the dependent and independent variables used in the analysis. The rationale for selection as well as the definition of each variable is discussed.

REMIS

The Reliability and Maintainability Information System (REMIS) is an on-line source of unclassified maintenance and supply data for all USAF aircraft. The maintenance information consists of R&M factors at the two through five digit Work Unit Code (WUC) level.

DEPENDENT VARIABLES

The operational data obtained from the REMIS database was used to solve for the dependent variables for the subject aircraft and subsystems. Listed below is the type of data obtained from REMIS.

Operation Time: Total number of hours aircraft is in use.

Sorties: Total number of flights consisting of a take-off and a landing.

Total Failures: Total number of maintenance actions including cannot duplicate, inherent failures, and maintenance induced failures.

Scheduled Maintenance Hours: Total number of hours required to complete scheduled maintenance work.

Unscheduled Maintenance Hours: Total number of hours required to complete unscheduled maintenance work both on and off the aircraft.

MTTR: Mean Time to Repair. Average length of time in hours to repair a subsystem. It is calculated by dividing the unscheduled manhours hours per subsystem by the subsystem Crew Size.

The time frame window for the Landing Gear (WUC 13) data is Jan 93 to Jul 95 and Aug 96 to Dec 96. The Engine (WUC 23) data time frame window is Jan 94 to Jul 95 and Aug 96 to Dec 96. Some aircraft may not have data listed in all of the time frames and some data may be missing for listed aircraft. REMIS data can be found in Appendix A and H for the Landing Gear and Engine, respectively.

The dependent variables were obtained using the data listed above. Below are the definitions for the dependent variables.

DEPENDENT VARIABLES DEFINED

MTBMOp

DEFINITION: Mean Time Between Maintenance, Operating Time. The average length of time, in operating hours, between all unscheduled failures.

COMPUTED: Operation Time divided by Total Failures.

MTBMS

DEFINITION: MTBM Sortie. The average length of time, in number of sorties, between all unscheduled failures.

COMPUTED: Sorties divided by Total Failures.

MH/MA

DEFINITION: Manhours per Maintenance Actions. The average length of time, in manhours, for repair of an unscheduled failure.

COMPUTED: Unscheduled Maintenance Hours divided by Total Failures.

SMH/FLYHR

DEFINITION: Scheduled Manhours per Flying Hour. The average number of scheduled maintenance manhours for every flying hour.

COMPUTED: Scheduled Maintenance Hours divided by Operation Time.

AVGCREW

DEFINITION: Average Crew. The mean number of maintenance personnel required to perform an unscheduled maintenance task.

COMPUTED: Manhours per Maintenance Action divided by Mean Time to Repair.

<u>DATA SOURCES</u>

Below are listed the sources used to obtain all the independent variable data. Below each source is the type of data taken from the source.

1. MIL-STD-1374 Group Weight Statement.
    - Weight Data
    - Landing and Sink Speeds
    - Number if Engines, Generators, and Fuel Tank
    - Maximum kVa
    - Maximum Speed
    - Oleo Data
    - Hydraulic System Data
    - Fuselage Volume

2. Aviation Week & Space Technology, Aerospace Source Book.
    - Empty and Gross Weights
    - Maximum Payload
    - Number of Engines
    - Maximum Speed
    - Average Length of Sortie
    - Engine Arrangement, Performance, Dimensions, and Weight Data
    - Length + Wingspan

3. Jane's All The World's Aircraft, Multiple Issues.
    - Weight Data
    - Number of Engines, Generator, Wheels, and Hydraulic Subsystems
    - Maximum kVa
    - Takeoff and Landing Ground Roll Data
    - Average Length of Sortie
    - Maximum Speed
    - Engine Performance Data
    - Length + Wingspan

4. USAF Standard Aircraft Characteristics
    - Weight Data
    - Landing and Sink Speeds
    - Takeoff and Landing Ground Roll Data
    - Number of Engines, Generators, and Wheels
    - Maximum Speed
    - Engine Data
    - Length + Wingspan
    - Fuselage Volume

5. Jane's Encyclopedia of Aviation.
    - Weight Data
    - Maximum Speed

6. The Encyclopedia of World Air Power.
    - Weight Data
    - Average Length of Sortie
    - Maximum Speed
    - Number of Wheels

7. The World's Military Aircraft.
    - Weight Data
    - Maximum Speed

8. USAF, Guide to the Modern US Air Force.
    - Weight Data
    - Average Length of Sortie
    - Maximum Speed

9. Modular Life Cycle Cost Model for Advanced Aircraft Systems - Phase III
    - BTU Cooling

INDEPENDENT VARIABLES

Note that, some of the independent variables listed below are not available to the designer until after the conceptual stage of design. Future work may be done that will allow the designers to predict the variables that are defined in the design phase using what they have available to them in the conceptual stage.

LANDING GEAR INDEPENDENT VARIABLES

The independent variables collected for the landing gear portion of the regression analysis were selected for their direct relationship to the reliability of the landing gear system. All of the independent variables selected are available to the designer in the early stages of aircraft design. The initial design of an aircraft consists of the conceptual and project definition phases. In the conceptual phase, the landing gear location and the number of wheels is determined. The number of wheels is dependent on the weight of the aircraft, brakes, and flotation requirements. At the end of conceptual design, the aircraft empty weight, length, wingspan, fuselage volume, and number of wheels have been determined and evaluated against cost, weight, availability, and complexity. In the project definition or preliminary design phase, the contractor, often in discussions with the customer and sub-contractors, better defines the aircraft weight, payload, and operational weight. The takeoff and landing loads along with the takeoff and landing speeds and airfield requirements establish the landing gear dimensions and weight. The landing speed and sink rate are also determined in this phase. The landing speed, sink rate and loading

factor, along with weights and other parameters, are used in defining the landing gear strength, weight, and the approximate stroke of the gear shock absorber. By the end of the project definition phase, the designer will have the following variables available: aircraft empty weight, operational weight, maximum payload, maximum landing weight, landing speed, sink rate, landing ground roll as well as takeoff ground roll, and weight and dimensions of the landing gear. The Preliminary Design Review will complete the preliminary design phase. From this point until the Critical Design Review, the Full-Scale Development (FSD) phase, all of the above data will be refined before manufacturing of parts begins. A pre-production prototype aircraft will be used to demonstrate that the basic design principles have been meet. The chose of hydraulic or electric power to actuate the gear will be determined in this phase and demonstrated on the prototype aircraft. At the completion of the FSD phase, the entire design is completed and presented to the customer at the Critical Design Review. At the Critical Design Review the contractor must characterize the life cycle cost and measures of reliability for the customer. After the Critical Design Review detailed design and production may begin.

LANDING GEAR INDEPENDENT VARIABLES DEFINED

WEIGHT EMPTY

SYMBOL: W1

SIGNIFICANCE: Aircraft design variable determined in conceptual stage of design. Empty weight influences landing speed and sink rate, takeoff and landing ground roll, oleo extend and travel, and number of wheels. All these factors relate to landing gear strength and dimensions. Landing gear that supports large weights may be more complex and require more maintenance.

DEFINITION: Measured weight of individual aircraft including airframe, engines, and all operating equipment that is permanently installed on aircraft. Optional equipment such as fixed ballast, hydraulic fluid, and residual, undrainable fuel and oil are also included. Removable equipment, crew and payload are not.

UNIT: lbs

DATA SOURCE: 1, 2, 3, 4, 5, 6, 7, 8.

AVERAGE OPERATIONAL GROSS WEIGHT

SYMBOL: W2

SIGNIFICANCE: Average Operational Gross Weight at Takeoff. Aircraft design variable determined during project definition phase. Operational gross weight is a factor in determining landing speed and sink rate, takeoff and landing ground roll, oleo extend and travel, and number of wheels. Factors into size and dimension of landing gear.

DEFINITION: Weight of aircraft on a typical operation mission including payload, weapons, crew, removable equipment, and fuel.

UNIT: lbs

DATA SOURCE: 1, 2, 3, 4, 5, 6, 7, 8.

MAXIMUM PAYLOAD

SYMBOL: W3

SIGNIFICANCE: Aircraft performance variable determined in the project definition phase. Used to obtain strength requirements of landing gear which controls landing gear size, weight, and complexity.

DEFINITION: Maximum load designated for transport on exterior and/or interior of aircraft.

UNIT: lbs

DATA SOURCE: 1, 2, 3, 4, 5, 6, 7, 8.

MAXIMUM DESIGN LANDING WEIGHT

SYMBOL: W4

SIGNIFICANCE: Aircraft design variable determined in project definition phase. Related to landing gear strength.

DEFINITION: Maximum design minus dropped tanks, fuel expended in one go-around (overshoot) or 3 min (whichever is less) and any items routinely dropped immediately after takeoff.

UNIT: lbs

DATA SOURCE: 1, 3, 4, 5

LIMIT LANDING SINK SPEED

SYMBOL: S1

SIGNIFICANCE: Aircraft performance variable determined in project definition phase. Weight of aircraft, flotation requirement, and airfield condition are taken into consideration when determining the sink speed. Sink speed is associated with strut length and shock absorber energy absorption. Higher landing load factors may directly influence reliability of gear.

DEFINITION: Vertical component of velocity of aircraft without propulsive or sustaining power in still air. Typical sink speed for US aircraft is 10 ft/s at design landing weight or 6 ft/s at maximum gross weight.

UNIT: ft/sec

DATA SOURCE: 1, 4.

STALL SPEED - LANDING CONFIGURATION

SYMBOL: S2

SIGNIFICANCE: Aircraft performance variable determined in project definition phase. Factors involved in determining landing stall speed include airfield condition, aircraft weight, and center of gravity. Landing speed is used in finding brake requirements and therefore can be associated with brake size and complexity. The higher the landing speed, the larger and more complex the braking system. It could be assumed the larger and more complex brake system would have more maintenance actions.

DEFINITION: Minimum true air speed to sustain forward flight. Aircraft is at design landing weight, landing configuration, power off, zero lift, 1g, and at Sea Level/International Standard Atmosphere (SL/ISA) conditions.

UNIT: Knots True Air Speed (ktas)

DATA SOURCE: 1, 4.

LANDING GROUND ROLL

SYMBOL: R1

SIGNIFICANCE: Landing Ground Roll at Maximum Design Landing Weight to Clear 50 Foot Obstacle. Aircraft performance variable determined during project definition phase. This parameter is associated with the amount of work produced by the brake system and also the strength of the landing gear system. A tactical cargo aircraft requiring a short ground roll will need a larger more complex braking system.

DEFINITION: Distance from point of touch down to complete stop. Aircraft must clear 50 foot obstacle at end of runway. Aircraft is at Maximum Design Landing Weight.

UNIT: ft

DATA SOURCE: 3, 4.

TAKEOFF GROUND ROLL

SYMBOL: R2

SIGNIFICANCE: Takeoff Ground Roll at Maximum Takeoff Weight to Clear 50 Foot Obstacle. Aircraft performance variable determined during project definition phase. This parameter assists in determining forces on the landing gear system at maximum weight and acceleration. This is taken into account in strength of design.

DEFINITION: Distance needed from brake release to lift-off to clear 50 foot obstacle at end of runway.

UNIT: ft

DATA SOURCE: 3, 4.

WEIGHT OF ALIGHTING GEAR GROUP

SYMBOL: GG

SIGNIFICANCE: Landing gear design variable determined during project definition phase. Weight of the landing gear system may be representative of the complexity and number of components in the system. Larger and more complex systems could be more prone to maintenance.

DEFINITION: Weight of the landing gear system to include the running gear, structure, and controls.

UNIT: lbs

DATA SOURCE: 1.

LENGTH - OLEO EXTENDED

SYMBOLS: O1 for nose or wing mounted gear, O2 for main - body mounted gear.

SIGNIFICANCE: Landing gear design variable determined during project definition phase. The length of landing gear may be a predictor of the number of moving parts such as struts, stabilizers, support structure, linkages, actuators, and shock absorbers. The longer the shock absorber the less stress on the system. However, longer gear may create a longer moment arm that may adversely affect the reliability and life cycle of the gear.

DEFINITION: Distance from centerline trunnion (main attachment point to airframe) to centerline of axle when there is no weight on wheels. Data compiled for nose or wing mounted gear and main or body mounted gear. Refers to Oleo-Pneumatic (Gas/Oil) shock absorbers only.

UNIT: inches

DATA SOURCE: 1.

OLEO TRAVEL

SYMBOLS: O3 for nose or wing mounted gear, O4 for main - body mounted gear.

SIGNIFICANCE: Landing gear design variable determined during project definition phase. The length of the shock strut assists in determining the forces exerted on the system.

DEFINITION: Distance shock piston travels to bottom out in cylinder. Oleo extended minus oleo travel is equal to length of gear. Data compiled for nose or wing mounted gear and main or body mounted gear. Refers to Oleo-Pneumatic (Gas/Oil) shock absorbers only.

UNIT: inches

DATA SOURCE: 1.

NUMBER OF WHEELS

SYMBOL: NW

SIGNIFICANCE: Landing gear design variable determined during conceptual phase of design. This parameter is found using the weight of the aircraft, brake requirement, and flotation requirements. (Currey, p15)

DEFINITION: Total number of primary landing gear wheels on aircraft.

DATA SOURCE: 3, 4, 6.

HYDRAULIC SYSTEM CAPACITY

SYMBOL: H1

SIGNIFICANCE: Aircraft design variable defined during project definition phase. The hydraulic system is associated with extending, retracting and steering of the landing gear. The size of the hydraulic system may be representative of the landing gear system size and the forces exerted on it.

DEFINITION: Number of gallons of hydraulic fluid contained in the entire hydraulic system to include piping, valves, pumps and other devices.

UNIT: gallons

DATA SOURCE: 1.

HYDRAULIC SYSTEM WEIGHT

SYMBOL: H2

SIGNIFICANCE: Work Unit Code 45, Hydraulic and Pneumatic Group Weight. Aircraft design variable defined in conceptual design phase. As above may represent the forces exerted on the landing gear system.

DEFINITION: Weight of hydraulic and pneumatic system to include piping, valves, pumps, and filters.

UNIT: lbs

DATA SOURCE: 1.

LENGTH + WINGSPAN

SYMBOL: LW

SIGNIFICANCE: Aircraft design variable determined during conceptual design phase. This variable may be associated with the mass of an aircraft and therefore the weight exerted on landing gear system.

DEFINITION: Length of aircraft fuselage plus wingspan.

UNIT: ft

DATA SOURCE: 2, 3, 4.

FUSELAGE VOLUME

SYMBOL: FV

SIGNIFICANCE: Aircraft design variable determined during the conceptual design phase. Associated with mass of aircraft.

DEFINITION: Volume of nose cone, fuselage, wings, horizontal and vertical tails, tail cone, and nacelles. Some aircraft volumes may not include nose and tail cone volumes.

UNIT: cubic feet

DATA SOURCE: 1, 4.

Table 1

LANDING GEAR INDEPENDENT VARIABLES LISTED

SYMBOL	VARIABLE	UNIT
W1	Weight Empty	lbs.
W2	Average Operational Gross Weight at TO	lbs.
W3	Maximum Payload	lbs.
W4	Maximum Design Landing Weight	lbs.
S1	Limit Landing Sink Speed	ft/sec
S2	Stall Speed - Landing Configuration	ktas.
R1	LDNG Grd Roll at Max Design LDNG Wgt Clear 50ft	ft.
R2	TO Ground Roll at Max TO Weight Clear 50ft	ft.
GG	Weight of Alighting Gear Group	lbs.
	Length - Oleo Extended	
	Axle to CL Trunnion	
O1	Nose or Wing	in.
O2	Main - Body	in.
	Oleo Travel	
	Extended to Collapsed	
O3	Nose or Wing	in.
O4	Main - Body	in.
NW	Number of Wheels	
H1	Hydraulic System Capacity	gal.
H2	WUC45 Hyd and Pneum Group Weight	lbs.
LW	Length + Wingspan	ft.
FV	Fuselage Volume	cu ft.

ENGINE INDEPENDENT VARIABLES

Integration of an engine into an aircraft is a difficult process that begins in the conceptual design phase with the definition of the performance requirements. The customer normally presents aircraft manufacturers with the design requirements which include aircraft range, payload, takeoff and landing distances, maneuverability, speed, and other military and/or civilian specifications. These are the parameters that the aircraft-engine system must meet. The manufacturers then enter the preliminary design phase. The engine manufacturers will use the design requirements to perform constraint and mission analyses that will give the manufacturers all the parameters needed to design an aircraft-engine system. These parameters include better-defined performance requirements, thrust-to-weight ratios at different flight regimes and configurations, thrust and wing loading at takeoff and landing, acceleration at takeoff, climb and level flight, maximum speed, fuel consumption, and many more. After all these parameters are obtained, the aircraft and engine manufacturers then begin designing an airframe and an engine that can best perform the mission. The engine manufacturer may already have an engine in existence that can meet all the requirements. If this is the case, then tests must be conducted to determine how the engine performs under all operating conditions of the aircraft's flight envelope. If a new engine design is required, the engine manufacturers then perform on-design cycle analysis.

> The object of cycle analysis is to obtain estimates of the performance parameters (primarily thrust and specific fuel consumption) in terms of design limitations (such as maximum allowable turbine temperature and attainable component efficiencies), the flight conditions (ambient pressure, temperature, and Mach number), and design choices (such as compressor pressure ratio, fan pressure ratio, bypass ratio, etc.). Mattingly, Heiser, Daley, p97.

In on-design cycle analysis, all the engine performance characteristics are determined for specific flight conditions. These characteristics include pressure ratios and combustion efficiencies. At the completion of on-design cycle analysis, off-design cycle analysis is performed. Here design point analysis and engine cycle selection is performed, giving engine performance under all operating conditions of the aircraft's flight envelope. Now the designer can determine the size, weight, and number of engines required on the aircraft. The maximum power, pressure ratio and other parameters are refined. Finally, detailed design begins and a prototype engine is produced to verify all characteristics.

Throughout detailed design the manufacturer must take reliability and life cycle cost into consideration. How strong and well-machined each part in the engine is can affect number of repairs, repair cost, and service life. The designer must weigh this against material and manufacturing cost. The designer must also consider accessibility for ease of repair and the amount of equipment needed to perform repairs.

ENGINE INDEPENDENT VARIABLE DEFINED

WEIGHT EMPTY

SYMBOL: W1

SIGNIFICANCE: Aircraft design variable determined during conceptual design phase. Influences the initial estimations for the size of engine required on aircraft.

DEFINITION: As above.

UNIT: lbs

DATA SOURCE: 1, 2, 3, 4, 5, 6, 7, 8.

MAXIMUM GROSS WEIGHT

SYMBOL: W5

SIGNIFICANCE: Aircraft design variable determined during conceptual design phase. Influence the initial determination of trust needed to accelerated aircraft. Large engines on a heavy aircraft may have more moving parts which can cause more maintenance actions.

DEFINITION: Maximum allowable weight of aircraft at takeoff to include crew, fuel, payload, munitions, equipment, etc. Taxi and run-up fuel not included.

UNIT: lbs

DATA SOURCE: 1, 2, 3, 4, 5, 6, 7, 8.

WEIGHT OF ENGINES

SYMBOL: W6

SIGNIFICANCE: Engine design variable based on aircraft weight and performance requirements. High maintenance actions may be indicative of high engine weights.

DEFINITION: Sum of dry weight of all engines on aircraft excluding tail pipes.

UNIT: lbs

DATA SOURCE: 1, 2, 4.

NUMBER OF ENGINES

SYMBOL: NE

SIGNIFICANCE: Aircraft design variable determined in conceptual design phase. May be associated with number of maintenance actions.

DEFINITION: Number of primary propulsion engines on aircraft.

DATA SOURCE: 1, 2, 3, 4.

NUMBER OF GENERATORS

SYMBOL: NG

SIGNIFICANCE: Aircraft design variable determined during project definition phase.

DEFINITION: Number of AC, DC and backup generators on aircraft.

DATA SOURCE: 1, 3, 4.

MAXIMUM KVA

SYMBOL: KV

SIGNIFICANCE: Aircraft design variable determined during project definition phase. May reflect stress placed on engines and therefore, may be a factor in determining mean time between maintenance.

DEFINITION: Maximum amount of kilovolt-amperes that can be produced by AC generators, alternators, engines, or other motors

UNIT: kVa

DATA SOURCE: 1, 3.

AVERAGE LENGTH OF SORTIE

SYMBOL: LS

SIGNIFICANCE: Aircraft design variable determined during project definition phase. Associated with number of operating hours on engines. Used in predicting rate of maintenance actions. Higher operating hours may result in more maintenance actions.

DEFINITION: Length of time aircraft is in operation.

UNIT: hrs

DATA SOURCE: 2, 3, 6, 8.

MAXIMUM SPEED

SYMBOL: MS

SIGNIFICANCE: Aircraft performance variable refined during project definition phase. May be associated with higher operating temperatures, RPMs, and therefore more stress on engines.

DEFINITION: Highest true air speed attainable in level flight in standard conditions.

UNIT: kts

DATA SOURCE: 1, 2, 3, 4, 5, 6, 7, 8.

NUMBER OF FAN/COMPRESSOR STAGES

SYMBOL: NF

SIGNIFICANCE: Engine design variable determined during development stage. Higher numbers of stages increase the number of blades and moving parts that have potential to fail.

DEFINITION: Total number of fans plus low, and high pressure compressor stages.

DATA SOURCE: 2.

NUMBER OF TURBINE STAGES

SYMBOL: NT

SIGNIFICANCE: Engine design variable determined during development stage. Number of turbine stages my influence number and length of maintenance actions.

DEFINITION: Total number of low, intermediate, and high pressure turbine stages.

DATA SOURCE: 2.

MAXIMUM POWER AT SEA LEVEL

SYMBOL: MP

SIGNIFICANCE: Engine performance variable.

DEFINITION: Power under Sea Level/International Standard Atmosphere (SL/ISA) conditions with engine operating at authorized limits of RPM, pressures, and temperatures.

UNITS: lbs t (thrust) or shp (shaft horsepower)

DATA SOURCE: 2.

OVERALL PRESSURE RATIO AT MAXIMUM POWER

SYMBOL: PR

SIGNIFICANCE: Engine performance variable.

DEFINITION: Compressor delivery pressure divided by ambient pressure (in supersonic aircraft, divided by ram pressure downstream of inlet).

DATA SOURCE: 2.

ENGINE MAXIMUM ENVELOPE DIAMETER

SYMBOL: ED

SIGNIFICANCE: Aircraft and engine design variable. Size of engine may be indicator of number of parts.

DEFINITION: Diameter of space in fuselage or nacelle that encompasses the engine.

UNIT: inches

DATA SOURCE: 2.

ENGINE MAXIMUM ENVELOPE LENGTH

SYMBOL: EL

SIGNIFICANCE: Aircraft and engine design variable.

DEFINITION: Length of space in fuselage or nacelle needed to fit engine.

UNIT: inches

DATA SOURCE: 2.

MAXIMUM POWER LOADING

SYMBOL: ML

SIGNIFICANCE: Aircraft design variable determined during project definition phase.

DEFINITION: Aircraft weight (usually Maximum Takeoff Gross Weight) divided by total propulsive power or trust at takeoff.

UNIT: lb/lb st (static thrust) or lb/shp

DATA SOURCE: 3.

HYDRAULIC SYSTEM WEIGHT

SYMBOL: H2

SIGNIFICANCE: Work Unit Code 45, Hydraulic and Pneumatic Group Weight. Aircraft design variable defined in conceptual design phase. This group is normally operated by engine power and therefore induces stress on the engines and affects reliability.

DEFINITION: As above.

UNIT: lbs

DATA SOURCE: 1.

HYDRAULIC SYSTEM CAPACITY

SYMBOL: H1

SIGNIFICANCE: Aircraft design variable defined during project definition phase. The size of the hydraulic system may be affect the amount of energy drawn form the engines to drive the system and therefore may impact reliability.

DEFINITION: As above.

UNIT: gallons

DATA SOURCE: 1.

NUMBER OF HYDRAULIC SUBSYSTEMS

SYMBOL: H3

SIGNIFICANCE: Aircraft design variable. This variable can be used to estimate the amount of power drawn from the engine to operate other systems with

added stress to engines. Hydraulic systems are normally driven by engine bleed air.

DEFINITION: Total number of subsystems requiring use of hydraulic or pneumatic power.

DATA SOURCE: 3.

ENVIRONMENTAL CONTROL SYSTEM WEIGHT

SYMBOL: AC

SIGNIFICANCE: Work Unit Code 41, Air Conditioning and Anti-Ice Group Weight. Assists in determining the about of power needed from the engines to run the air conditioning and anti-icing devices.

DEFINITION: Total weight of air conditioning system and anti-icing system combined.

UNIT: lbs

DATA SOURCE: 1.

BTU COOLING

SYMBOL: BC

SIGNIFICANCE: Aircraft cooling normally uses engine power and therefore puts stress on the engines.

DEFINITION: Total cooling capacity of all air conditioning equipment.

UNIT: BTU/hr/1000

DATA SOURCE: 9

FUEL SYSTEM WEIGHT

SYMBOL: FS

SIGNIFICANCE: Work Unit Code 46, Fuel System Weight. This factor may be a predictor of the size of the fuel system and amount of fuel flow to the engines. The fuel flow rate may predict the generation of an engine (low fuel efficiency) or the high operating power of an engine. Both these are attributes that affect reliability.

DEFINITION: Weight of fuel system to include tanks, plumbing, and vents.

UNIT: lbs

DATA SOURCE: 1.

FUSELAGE VOLUME

SYMBOL: FV

SIGNIFICANCE: Aircraft design variable determined during conceptual design phase. Can be attributed to the mass that engines must move and therefore the forces produced by the engines and the wear and tear that impacts reliability.

DEFINITION: As above.

UNIT: cubic feet

DATA SOURCE: 1, 4.

Table 2

ENGINE INDEPENDENT VARIABLES LISTED

SYMBOL	VARIABLE	UNIT
W1	Weight Empty	lbs.
W5	Maximum Gross Weight	lbs.
W6	Weight of Engines	lbs.
NE	Number of Engines	
NG	Number of Generators	
KV	Maximum KVA	KVA
LS	Average Length of Sortie	hrs.
MS	Maximum Speed	kts.
NF	Number of Fan/Compressor Stages	
NT	Number of Turbine Stages (HP/LP)	
MP	Maximum Power at Sea Level	lbs t. or shp
PR	Overall Pressure Ratio at Maximum Power	
ED	Engine Maximum Envelope Diameter	in.
EL	Engine Maximum Envelope Length	in.
ML	Maximum Power Loading	lb/lb st or lb/shp
H2	WUC45 Hyd and Pneum Group Weight	lbs.
H1	Hydraulic System Capacity	gal.
H3	Number of Hydraulic Subsystems	
AC	WUC41 A/C & Anti-Ice Group Weight	lbs.
BC	BTU Cooling	BTU/hr/1000
FS	WUC46 Fuel System Weight	lbs.
FV	Fuselage Volume	cu ft.

CHAPTER 4

METHODOLOGY

This chapter will discuss in detail the approach used to obtain and transform the data, perform multiple regression, and develop the predicting equations.

DATA COLLECTION AND TRANSFORMATION

Research began with the selection of driver variables that directly influence the reliability of the landing gear and engine systems. Criteria for selection of landing gear independent variables include weight supported by the system, dimensions of the system, and factors that influence forces on the system such as landing speed and sink speed. The selection criteria for the engine independent variables consist of factors that influence the forces required to accelerate an aircraft such as weights and dimensions, size of systems that draw power from the engines such as hydraulic and cooling systems, and number of components in the engines. After all the independent variables were selected the data points were obtained using the sources listed in Chapter Three. The landing gear data is listed in Appendix C and the engine data is listed in Appendix J. At the completion of all the independent variable data collection, the dependent variables were determined using R&M data obtained from the REMIS database. The dependent variables were computed as shown in Chapter Three. The list of the dependent variables are in Appendix A and Appendix H for the landing gear and engine systems, respectively. The choice of

dependent variables was made to give the designer a feel for how reliable and maintainable the system will be and where to make improvements, if need be, to satisfy customer reliability and maintainability requirements. Once all the independent and dependent variables were collected, the landing gear and engine databases were imported into NCSS version 6.0.22, a statistical software program. A correlation matrix was produced in NCSS that provided the correlations between the landing gear independent and dependent variables and the engine independent and dependent variables. The correlation reports are shown in Appendix E and L. From the correlation matrix, three or four independent variables with the highest correlation factors were selected for each dependent variable. Each dependent variable and its associated independent variables were input into a different spreadsheets in NCSS. These spreadsheets can be found in Appendix D and K for the landing gear and engines, respectively. The next step was to plot each of the selected three or four independent variables against the respective dependent variable. This was done to observe the relationship between the independent and dependent variables. If the relationship was not a straight line, the independent variable was appropriately transformed in an attempt to create a straight line. Each independent variable was transformed in several ways, as shown in the data sheets in Appendix D and K. The next step was to perform multiple regression analysis.

MULTIPLE REGRESSION ANALYSIS

After all the data was prepared, NCSS was used to perform the regression analysis. Before regression was started, success had to be defined in terms of statistical parameters

that had to be met. The following are the success criteria that were used to accept the results of the regression.

1. The R-Squared value must be .70 or greater.
2. The T-Value of the regression coefficient must have been significant (large).
3. The Prob Level or p-value for the significance test of the regression coefficient must have been less than or equal to .10.
4. The 95 percent Confidence Limit must not include zero.
5. Adequate sample size to insure sufficient degrees of freedom for error (min of 4).
6. The Prob Level for the F-Test under the Analysis of Variance Section must be less than or equal to .10.

To obtain a sense of what independent variables to use in the regression analysis, an NCSS function called "All Possible Regression" was performed. To perform this function, a group of p independent variables was chosen for a specific dependent variable. The "All Possible Regression" function then fit all regressions using one regressor through all p regressors. The champions for each subset size were listed with their respective R-Squared and Cp value. An R-Squared of .70 or greater and a Cp value close to p+1 was the acceptance criteria for a regressor combination that may perform well under multiple regression analysis. In an attempt to keep the predicting equations to a manageable size and still have reasonable accuracy, only the two through five regressor subsets were used to obtain acceptable regressor combinations.

With these "All Possible Regression" results as a guide, multiple regression was performed on many different regression combinations. This was done until an acceptable combination was found that met at least four out of the six acceptance criteria listed

above. The output results for NCSS provided a list of Predicted Values With Confidence Limits of Individuals and a Residual Report list. These lists were used to find any outliers in the data set that could be eliminated in order to tighten the fit and obtain better coefficients. After many iterations of multiple regression an optimal solution was found for each dependent variable. The solutions can be found in Appendix F and M. The next step was to develop the predicting equations from the optimal solutions.

PREDICTING EQUATIONS

Multiple regression attempts to fit a straight-line among several variables to study the relationship between one dependent variable and several independent variables. In multiple-linear regression, the coefficients in the regression equation are obtained. With the regression coefficients provided by NCSS, the predicting equations were developed in Microsoft Word 7.0. The equations will be listed in Chapter 5, Results.

CHAPTER 5

RESULTS

This chapter develops the prediction equations from the results obtained from the regression analysis performed by NCSS. All regression results can be found in Appendix F for the landing gear and M for the engines.

LANDING GEAR

MTBMOp

After many iterations of regression using different numbers and combinations of independent variables, all results demonstrated a poor representation of MTBMOp by the independent variables in the model. This is logical because the use of landing gear is not dependent on the amount of time the aircraft is in use. The majority of time an aircraft is in operation, the landing gear is retracted or stationary. The only critical times for landing gear use are during takeoff, landing, retracting, and extending. Landing gear are under the greatest stress at these times and their reliability is represented better by number of times used rather than time in use. One of the better results obtained can be found in Appendix F. Note the R-Squared value of .557129 indicating the poor fit.

MTBMS

The results obtained from NCSS met all success criteria. The data was adjusted to eliminate several outliers. The results from this regression were better than that of MTBMOp. MTBMS gives time between maintenance in number of sorties. This is a more reasonable way to measure MTBM for a landing gear system because landing gear reliability is dependent on number of times used rather than time aircraft is in operation. Predicted MTBMS for landing systems can be calculated using the equation below.

$$MTBMS = 26.32477 - .0093729 51\sqrt{W2} + 13.28845\sqrt{O4} - 59.99788(\log(O4))$$

MH/MA

All but two of the six success criteria were met by the regression results. The Prob Level for the independent variable LN Fuse Vol is greater than .10 and the Confidence Limit for that variable includes zero. The R-Squared value of .697594 was taken as equal to .70. Data was adjusted by eliminating several outliers to obtain a better fit. MH/MA can be predicted using the equation below.

$$MH / MA = 664.3605 - 6.929825(O2) + 243.2979\sqrt{O2} - .03721993\sqrt{FV} - 521.1387(\ln(O2)) + 1.021577(\ln(FV))$$

SMH/FLYHR

After eliminating several outliers the result obtained was acceptable. Stall Speed Land Conf is the only variable with Prob Level greater than .10 and Confidence Limit that includes zero. The formula for predicting SMH/FLYHR is shown below.

$$SMH\,/\,FLYHR = 2.190422 - .0001160511(S2) - .0002416306(GG) + .04635748\sqrt{GG}$$
$$-.4802878(\ln(GG)) + .000000002295069(GG)^2$$

AVGCREW

The results of this regression produced excellent results. Predicted AVGCREW is given by the equation below.

$$AVGCREW = 130.4958 - .00001617608(W4) + 3.888708(O2) - 42.96297\sqrt{O2} + .1757128\sqrt{H2}$$
$$-.008796215(O2)^2$$

ENGINE

MTBMOp

Surprisingly, the result for MTBMOp was not as good as expected. Given that the engines of an aircraft are running the entire time the aircraft is in operation, it is assumed that time between maintenance would be better measured using operation time. The results obtained for MTBMOp are marginal. The variable Hyd Sys Cap has a Prob Level almost greater than .10 and the Confidence Limit includes zero. The predicted MTBMOp can be found using the equation below.

$$MTBMOp = 11.12525 + .05280196(H1) - 1.451915\sqrt{H1}$$

MTBMS

The results for MTBMS met all criteria except that the Confidence Limit for LN WUC 46 includes zero. The R-Squared value is exceptional. One would not expect regression of engine data to produce a better fit of MTBMS, however, in this case the results for MTBMS were better than those for MTBMOp. Predicted MTBMS for engines can be calculated using the equation below.

$$MTBMS = 307.4667 + .008800491(W6) - .6281232\sqrt{W6} + 3.089895(\ln(FS)) - 311.1282e^{W6/66420} + 83.17032e^{FS/11422.2}$$

MH/MA

The independent variables selected gave a good R-Squared value, however, the Prob Level is greater than .10 for one variable and the Confidence Limit includes zero for two of the variables. MH/MA can be predicted using the equation below.

$$MH / MA = 7.86466 - .01154961(H1) - .3577731(LS) - 350.807e^{-H1}$$

SMH/FLYHR

SMH/FLYHR had excellent results. All success criteria was met. The equation is listed below.

$$SMH / FLYHR = -.3442549 + .0295859(ML)^2 + .01280169(NE)^2 + 1.747529e^{-ML}$$

AVGCREW

The results for AVGCREW were good except for the fact that there is a small number of degrees of freedom. Only 7 points were used to fit the line so there are only 6 total degrees of freedom and 5 error degrees of freedom. Fitting a line through so few points gives results that are general and are not specific to the dependent variable. This was caused by the fact that there is only one independent regression variable. All success criteria have been met, however. The equation for predicting AVGCREW is below.

$$AVGCREW = 5.167743 - 2.390222(\ln(ML))$$

CHAPTER 6

SUMMARY AND CONCLUSIONS

The results of this report will support an R&M computer model developed by Dr. Charles E. Ebeling, of the University of Dayton, for NASA that will allow them to predict reliability and maintainability of a reusable launch vehicle. The equations developed by this report will allow for a more accurate prediction of operational mission rates and supportability costs. This will give the designer valuable information on how well the system will perform over its life cycle. The designer can then effectively predict the amount of spares and manpower needed for a system.

The results for the landing gear tended to be better due to the fact that they have more variables and more degrees of freedom.

A means of obtaining better results may have been to choose an aircraft type rather than USAF aircraft in general. Since launch vehicles are normally large and complex, it may have been better to select the cargo/tanker and/or bomber group as independent variables. Data for all cargo/tanker or bomber aircraft for the last 40 years may have produced better regression results. There may be several downfalls to this. First, R&M data may not be available for many older aircraft that are no longer in the Air Force inventory. Therefore, the dependent variables may not be obtained. Second, the regression may expose multicollinearity which may make the results less optimal. Third, a

technology factor would have to be used to equal out the differences technology many have played in improving reliability for the more modern aircraft. If the above factors can be remedied, the results of regression could provide equations that are more accurate.

APPENDIX A

Appendix A

Landing Gear Reliability and Maintainability Data

YEAR	EQ_DESIG	OP_TIME	SORTIES	TOTAL_FAIL	SCHED_HR	UNSCHED_HRS	MTTR		YEAR	EQ_DESIG	OP_TIME	SORTIES
--	-- --------	-------	-------	----------	-----------	-----------	----		--	-- --------	-------	--------
1993	A010A	76,513.40	44368	1,066	1,292.20	6,748.10	0		1994	A010A	75,596.70	40826
	B001B	30,162.70	6604	737	593	4,949.60	0			B001B	28,940.70	6646
	B002A	490.6	116	2	0	4.2	0			B002A	1,189.00	302
	B052H	35,715.10	5836	1,809	1,221.80	9,126.70	0			B052H	26,911.60	4561
	C005B	51,186.80	11869	2,083	1,618.70	6,983.70	0			C005B	42,708.80	10678
	C009A	24,813.10	18323	291	458.8	2,192.30	0			C009A	24,519.80	17676
	C017A	1,676.80	640	0	239	24	0			C017A	6,144.70	2204
	C130H	98,344.40	47915	1,453	4,143.50	10,109.20	0			C130H	100,867.50	50085
	C141B	174,303.80	55913	2,454	3,916.70	10,270.60	0.01			C141B	143,402.00	48644
	E003B	20,603.60	2590	309	260.3	2,462.20	0			E003B	17,635.40	2358
	F004E	4,535.50	3770	125	106.7	477.2	0			F004E	4,126.90	3427
	F015C	104,714.00	68157	1,502	497.1	11,855.20	0			F015C	101,157.30	66027
	F016C	258,778.60	180512	4,079	3,023.60	36,256.70	0			F016C	261,796.10	178033
	F111F	19,173.00	8327	562	450.7	5,264.80	0			F111F	17,748.70	7808
	F117A	12,204.70	6885	154	14	1,085.70	0			F117A	12,424.40	6880
	KC010A	52,148.90	11606	648	35	1,800.50	0			KC010A	50,196.30	11442
	KC135A	12,265.50	3049	202	304	2,033.60	0			KC135A	1,742.50	410
	T001A	22,896.80	9180	215	156.2	843.6	0			T001A	35,875.20	14804
	T037B	175,587.00	136986	2,371	5,079.50	7,040.70	0			T037B	143,950.50	112178
	T038A	202,550.90	168198	4,435	4,799.20	14,190.70	0			T038A	165,125.40	137367
	T043A	5,608.60	2237	62	26.2	439.1	0			T043A	5,695.20	2052
										U002R	487.4	235

Appendix A

Landing Gear Reliability and Maintainability Data

TOTAL_FAIL	SCHED_HRS	UNSCHED_HR	MTTR		YEAR	EQ_DESIG	OP_TIME	SORTIES	TOTAL_FAIL	SCHED_HR	UNSCHED_HR	MTTR
12,577	12,185.20	69,210.60	0		1995	A010A	43,154.90	22636	3,314	4,321.10	23,126.70	0
10,618	9,285.70	56,194.80	0			B001B	16,056.70	3701	2,561	1,118.50	24,673.70	0
607	314.4	2,270.30	0			B002A	1,512.00	333	398	228.9	2,968.10	0
17,851	18,078.70	75,180.20	0			B052H	14,250.80	2334	3,626	3,406.60	19,775.50	0
34,901	25,219.80	109,575.10	0			C005B	20,308.70	5330	9,883	6,317.90	33,035.50	0
5,603	4,587.60	28,725.90	0			C009A	14,527.30	10258	1,318	977.2	5,526.10	0
1,495	529.6	5,864.30	0			C017A	7,949.80	2673	0	2	0	0
26,320	49,371.30	111,438.80	0			C130H	61,122.90	29871	6,959	18,063.20	35,115.80	0
40,434	37,797.20	154,371.30	0			C141B	93,927.50	30154	11,885	15,273.90	64,174.30	0.01
4,121	5,304.70	18,908.50	0			E003B	10,099.00	1492	1,287	1,386.40	6,659.00	0
1,015	900.2	4,293.40	0			F004E	2,571.80	2121	419	453	1,432.60	0
21,762	17,198.20	106,090.60	0			F015C	63,434.90	40503	6,089	3,450.30	52,548.50	0
45,745	33,503.60	265,555.50	0			F016C	163,075.60	109152	18,123	15,003.40	125,310.30	0
5,427	4,759.80	34,583.40	0			F111F	9,592.70	4177	1,131	1,517.10	11,463.60	0
1,527	366.6	9,036.70	0			F117A	7,553.40	4507	516	93.7	5,685.10	0
7,449	4,741.90	24,590.80	0			KC010A	27,967.00	5889	2,102	608.5	6,888.60	0
1,108	1,082.90	10,860.00	0			KC135A	0	0	0	0	470.7	0
3,315	3,409.70	13,540.40	0			T001A	24,032.60	10451	1,152	1,466.20	5,308.20	0
25,305	40,529.70	87,216.70	0			T037B	80,246.10	62792	8,144	17,596.10	24,856.10	0
46,002	35,320.20	156,291.00	0			T038A	82,072.30	69176	13,827	13,016.00	38,815.40	0
1,196	2,447.50	6,551.60	0			T043A	4,274.70	1457	215	253	1,702.90	0
175	417.6	600.2	0			U002R	1,790.80	970	626	2,106.10	2,451.30	0

Appendix A
Landing Gear Reliability and Maintainability Data

YEAR	EQ_DESIG	OP_TIME	SORTIES	TOTAL_FAIL	SCHED_HRS	UNSCHED_HR	MTTR			Sum Op Time	Total Sorties
----	---------	--------	--------	-----------	------------	------------	----				
1996	A010A	29,782.30	15611	2,327	4,813.50	23,010.40	3.35			225,047.30	123441
	B001B	10,333.30	2226	1,292	2,132.70	19,724.10	3.15			85,493.40	19177
	B002A	1,266.00	277	176	259.3	2,863.20	3.75			4,457.60	1028
	B052H	8,978.60	1303	2,198	4,143.20	15,571.00	1.68			85,856.10	14034
	C005B	13,022.30	2848	5,951	4,086.00	21,402.10	1.35			127,226.60	30725
	C009A	8,322.60	5281	734	490.7	2,540.60	1.86			72,182.80	51538
	C017A	7,264.60	2455	0	0	0	0			23,035.90	7972
	C130H	47,430.20	22157	5,284	19,870.10	41,586.00				307,765.00	150028
	C141B	43,419.10	13836	5,195	8,142.90	32,355.90	2.46			455,052.40	148547
	E003B	6,176.00	873	500	735.7	5,626.20	2.58			54,514.00	7313
										0.00	0
	F004E	1,697.90	1403	243	188	1,256.70	1.36			12,932.10	10721
	F015C	37,568.90	24409	4,132	1,919.30	31,932.70	2.32			306,875.10	199096
	F016C	112,200.20	74979	13,472	18,208.50	126,410.60				795,850.50	542676
	F111F	0	0	0	0	446	2.23			46,514.40	20312
	F117A	5,087.70	2927	205	38	1,609.60	2.33			37,270.20	21199
	KC010A	17,743.70	3667	1,057	220.4	5,115.20	2.15			148,055.90	32604
	KC135A	17.3	11	0	4	0	2			14,025.30	3470
	T001A	22,237.30	10238	918	1,838.80	4,581.60	1.03			105,041.90	44673
	T037B	58,703.90	46014	4,894	12,211.70	16,681.70	0.76			458,487.50	357970
	T038A	45,342.20	38507	7,922	7,149.20	30,517.20				495,090.80	413248
	T043A	2,057.00	712	115	177.6	1,137.60	2.58			17,635.50	6458
	U002R	1,457.90	512	258	665.2	2,155.00	2.64			3,736.10	1717

Appendix A
Landing Gear Reliability and Maintainability Data

Sum Total Fail	Sum Sched Hr	Sum Unsche H	Sum MTTR			MTBM op/fail	MTBM sortie/fail	MH/MA unsch/fail	SMH/FLY HRsch/op	AvgCrews izeav/aq
19,284	22,612.00	122,095.80	3.35			11.67016	6.401213	6.331456	0.100477	1.889987
15,208	13,129.90	105,542.20	3.15			5.621607	1.260981	6.939913	0.153578	2.203147
1,183	802.60	8,105.80	3.75			3.768047	0.868977	6.851902	0.180052	1.827174
25,484	26,850.30	119,653.40	1.68			3.36902	0.550698	4.695236	0.312736	2.794783
52,818	37,242.40	170,996.40	1.35			2.408774	0.581715	3.237465	0.292725	2.398122
7,946	6,514.30	38,984.90	1.86			9.084168	6.486031	4.90623	0.090247	2.637758
1,495	770.60	5,888.30	0			15.40863	5.332441	3.938662	0.033452	0
40,016	91,448.10	198,249.80	0			7.691049	3.7492	4.954263	0.297136	0
59,968	65,130.70	261,172.10	2.48			7.588254	2.477104	4.355191	0.143128	1.756125
6,217	7,687.10	33,655.90	2.58			8.768538	1.176291	5.413527	0.141011	2.098266
0	0.00	0.00	0			0	0	0	0	0
1,802	1,647.90	7,459.90	1.36			7.176526	5.949501	4.139789	0.127427	3.043963
33,485	23,064.90	202,427.00	2.32			9.164554	5.945826	6.045304	0.075161	2.605734
81,419	69,739.10	553,533.10	0			9.774752	6.665226	6.798574	0.087628	0
7,120	6,727.60	51,757.80	2.23			6.532921	2.852809	7.269354	0.144635	3.2598
2,402	512.30	17,417.10	2.33			15.51632	8.825562	7.251082	0.013746	3.112053
11,256	5,605.80	38,395.10	2.15			13.15351	2.896588	3.411079	0.037863	1.586548
1,310	1,390.90	13,364.30	2			10.70634	2.648855	10.20176	0.099171	5.100878
5,600	6,870.90	24,273.80	1.03			18.75748	7.977321	4.334607	0.065411	4.208356
40,714	75,417.00	135,795.20	0.76			11.26118	8.792307	3.335344	0.164491	4.388611
72,186	60,284.60	239,814.30	0			6.858543	5.724767	3.322172	0.121765	0
1,588	2,904.30	9,831.20	2.58			11.10548	4.066751	6.190932	0.164685	2.399586
1,059	3,188.90	5,206.50	2.64			3.527951	1.621341	4.916431	0.853537	1.862284

APPENDIX B

Appendix B
Landing Gear Independent Variables List

LANDING GEAR INDEPENDENT VARIABLES LISTED

SYMBOL	VARIABLE	UNIT
W1	Weight Empty	lbs.
W2	Average Operational Gross Weight at TO	lbs.
W3	Maximum Payload	lbs.
W4	Maximum Design Landing Weight	lbs.
S1	Limit Landing Sink Speed	ft/sec
S2	Stall Speed - Landing Configuration	ktas.
R1	LDNG Grd Roll at Max Design LDNG Wgt Clear 50ft	ft.
R2	TO Ground Roll at Max TO Weight Clear 50ft	ft.
GG	Weight of Alighting Gear Group	lbs.
	Length - Oleo Extended	
	Axle to CL Trunnion	
O1	Nose or Wing	in.
O2	Main - Body	in.
	Oleo Travel	
	Extended to Collapsed	
O3	Nose or Wing	in.
O4	Main - Body	in.
NW	Number of Wheels	
H1	Hydraulic System Capacity	gal.
H2	WUC45 Hyd and Pneum Group Weight	lbs.
LW	Length + Wingspan	ft.
FV	Fuselage Volume	cu ft.

APPENDIX C

Appendix C
Landing Gear Independent and Dependent Variables

Vehicle	Weight Empty	Average Gross Weight	Maximum Payload	Max Design Landing Weight	Limit Landing Sink Spd	Stall Speed - Ld Config	LND Grd Roll at Max LND Wgt	TO Grd Roll at Max TOW	Weight of Gear Group	Oleo Extend Nose or Wing	Oleo Extend Main	Oleo Travel Nose or Wing
A-10A	22060.6	41428.5	16000	33245	10	91.5	2000	4000	1485.5	70.6	62.8	13
B-1B	182271	434358.3	75000	263328	10	126			16234.4	117.2	130.1	21
B-2A	152723	336500	50000						12852	115.6	96.6	18
B-52H	170252	480400	65000	270000				9500	13522	82.3	62.7	20.5
C-5B	363458.3	576910	291000	635850	9	102	3800	11000	38282.1	55.1	80.8	22
C-9A	61872	88461	24749	99000	10	99	3000	5360	4174	65.63	48.2	16.94
C-17A	269612	414780	172200	580000	9	140	4000	8320	23184	76.1	50.1	22
C-130H	73962	118811	49818	130000	9	100	3700	7050	5064	49.83	57.65	10.5
C141B	140821	271197	90880	323100	6	122	4680	6710	10850	41.5	61.7	12
E-3A	166544	325000		250000	10	108			12845	55.7	91	16
E-4B	500000							5000				
F-4E	31514	57000	16000	46000	10	118	3800	4490	1944	72.1	61.8	24
F-15C	28473	45688	20000	35000	10		3600	1200	1399	66.6	50.1	16.5
F-16C	18656	28000	15200	31000	12.5	108			1186.2	39	49.9	10
F-111F	46969.8	83000	30000	82500	10		3000	3000	2629.5	54.18		16.59
F-117A	28440.1	48000	5000			150			1741.7	68.55	60	14
KC-10A	238741	514500	169409	436000	10	125			26353	97	131	17
KC-135A	96412	270000	119200	185000	8	101	4700	9050	10161	55.7	91.9	16
T-1A	9993.25	13772	2000	15700	10	107	3515	5500	627.17	33.13	32.53	8.7
T-37B	4073	5736	2512.6	6097.8	11	70	3500	2390	332.67	30.587	31.711	7.25
T-38A	7621.4	10471	4431	10770	10.6	130	5200	3700	528.4	40	49.1	8
T-43A	63874	70320	44999	103000	10	102	5265	6650	4586	46	74.9	12
U-2R	15101	15850						800				

Appendix C

Landing Gear Independent and Dependent Variables

Oleo Travel Main	Number of Wheels	Hydraulic System Capacity	WUC45	Length+Wingspan	Fuselage Volume	MTBM op/fail	MTBM sortie/fail	MH/MA unsch/fail	SMH/FLY HRsch/op	AvgCrewsizeav/aq
15	3		373.2	110.8	793	11.67016	6.401213	6.331456	0.100477	1.889987
16.5	10	167	2701.9	282.8	9334	5.621607	1.260981	6.939913	0.153578	2.203147
18	10		4649	241		3.768047	0.868977	6.851902	0.180052	1.827174
18	10	80.3	2024	345	12447	3.36902	0.550698	4.695236	0.312736	2.794783
25	28	282	4483.7	470.5	86610.1	2.408774	0.581715	3.237465	0.292725	2.398122
15	6		752	213	7647	9.084168	6.486031	4.90623	0.090247	2.637758
22.1	14	240	5187	343.8	38290	15.40863	5.332441	3.938662	0.033452	
10.5	6	18.9	666	230.4	9060	7.691049	3.7492	4.954263	0.297136	
28	10		1605	328.3	19700	7.588254	2.477104	4.355191	0.143128	1.756125
22	10	55	796	299	16002	8.768538	1.176291	5.413527	0.141011	2.098266
	18			427						
15.9	4	23	543	101.3	1473	7.176526	5.949501	4.139789	0.127427	3.043963
9	3	22.9	437	106.6	1830	9.164554	5.945826	6.045304	0.075161	2.605734
10.5	3		310.3	80	774.93	9.774752	6.665226	6.798574	0.087628	
17.87	4	35	646	136.5	2089	6.532921	2.852809	7.269354	0.144635	3.2598
9	3		1206.9	109.2	2280	15.51632	8.825562	7.251082	0.013746	3.112053
24	12		4166	347	41300	13.15351	2.896588	3.411079	0.037863	1.586548
22	10	43	865	267	11550	10.70634	2.648855	10.20176	0.099171	5.100878
8.5	3		152.46	91.9		18.75748	7.977321	4.334607	0.065411	4.208356
8.5	3		52.58	63.1		11.26118	8.792307	3.335344	0.164491	4.388611
11.5	3	5.19	147.2	71.6	489	6.858543	5.724767	3.322172	0.121765	
14	6	23.8	568.1	193	10231	11.10548	4.066751	6.190932	0.164685	2.399586
	8			129.6		3.527951	1.621341	4.916431	0.853537	1.862284

APPENDIX D

Appendix D
Landing Gear MTBM Op Regression Data

Vehicle	Oleo Trav	Oleo Trav	Number o	Length + V	SQRT of C	SQRT of C	SQRT of #	SQRT of L	LN of Oleo
A-10A	13	15	3	110.8	3.605551	3.872983	1.732051	10.52616	2.564949
B-1B	21	16.5	10	282.8	4.582576	4.062019	3.162278	16.81666	3.044522
B-2A	18	18	10	241	4.242641	4.242641	3.162278	15.52417	2.890372
B-52H	20.5	18	10	345	4.527693	4.242641	3.162278	18.57418	3.020425
C-5B	22	25	28	470.5	4.690416	5	5.291503	21.69101	3.091042
C-9A	16.94	15	6	213	4.115823	3.872983	2.44949	14.59452	2.829678
C-17A	22	22.1	14	343.8	4.690416	4.701064	3.741657	18.54184	3.091042
C-130H	10.5	10.5	6	230.4	3.24037	3.24037	2.44949	15.17893	2.351375
C141B	12	28	10	328.3	3.464102	5.291503	3.162278	18.11905	2.484907
E-3A	16	22	10	299	4	4.690416	3.162278	17.29162	2.772589
E-4B			18	427			4.242641	20.66398	
F-4E	24	15.9	4	101.3	4.898979	3.98748	2	10.06479	3.178054
F-15C	16.5	9	3	106.6	4.062019	3	1.732051	10.32473	2.80336
F-16C	10	10.5	3	80	3.162278	3.24037	1.732051	8.944272	2.302585
F-111F	16.59	17.87	4	136.5	4.073082	4.227292	2	11.68332	2.8088
F-117A	14	9	3	109.2	3.741657	3	1.732051	10.44988	2.639057
KC-10A	17	24	12	347	4.123106	4.898979	3.464102	18.62794	2.833213
KC-135A	16	22	10	267	4	4.690416	3.162278	16.34013	2.772589
T-1A	8.7	8.5	3	91.9	2.949576	2.915476	1.732051	9.586449	2.163323
T-37B	7.25	8.5	3	63.1	2.692582	2.915476	1.732051	7.943551	1.981001
T-38A	8	11.5	3	71.6	2.828427	3.391165	1.732051	8.461678	2.079442
T-43A	12	14	6	193	3.464102	3.741657	2.44949	13.89244	2.484907
U-2R			8	129.6			2.828427	11.3842	

Appendix D
Landing Gear MTBM Op Regression Data

LN of Ole	LN # of W	LN of Len	SQ of Ole	SQ of Ole	SQ of # of	SQ of Len	LOG Oleo	LOG Oleo	LOG # of
2.70805	1.098612	4.707727	169	225	9	12276.64	1.113943	1.176091	0.477121
2.80336	2.302585	5.64474	441	272.25	100	79975.84	1.322219	1.217484	1
2.890372	2.302585	5.484797	324	324	100	58081	1.255273	1.255273	1
2.890372	2.302585	5.843544	420.25	324	100	119025	1.311754	1.255273	1
3.218876	3.332205	6.153796	484	625	784	221370.3	1.342423	1.39794	1.447158
2.70805	1.791759	5.361292	286.9636	225	36	45369	1.228913	1.176091	0.778151
3.095578	2.639057	5.84006	484	488.41	196	118198.4	1.342423	1.344392	1.146128
2.351375	1.791759	5.439817	110.25	110.25	36	53084.16	1.021189	1.021189	0.778151
3.332205	2.302585	5.793928	144	784	100	107780.9	1.079181	1.447158	1
3.091042	2.302585	5.700444	256	484	100	89401	1.20412	1.342423	1
	2.890372	6.056784			324	182329			1.255273
2.766319	1.386294	4.618086	576	252.81	16	10261.69	1.380211	1.201397	0.60206
2.197225	1.098612	4.669084	272.25	81	9	11363.56	1.217484	0.954243	0.477121
2.351375	1.098612	4.382027	100	110.25	9	6400	1	1.021189	0.477121
2.883123	1.386294	4.916325	275.2281	319.3369	16	18632.25	1.219846	1.252125	0.60206
2.197225	1.098612	4.693181	196	81	9	11924.64	1.146128	0.954243	0.477121
3.178054	2.484907	5.849325	289	576	144	120409	1.230449	1.380211	1.079181
3.091042	2.302585	5.587249	256	484	100	71289	1.20412	1.342423	1
2.140066	1.098612	4.520701	75.69	72.25	9	8445.61	0.939519	0.929419	0.477121
2.140066	1.098612	4.144721	52.5625	72.25	9	3981.61	0.860338	0.929419	0.477121
2.442347	1.098612	4.271095	64	132.25	9	5126.56	0.90309	1.060698	0.477121
2.639057	1.791759	5.26269	144	196	36	37249	1.079181	1.146128	0.778151
	2.079442	4.864453			64	16796.16			0.90309

Appendix D
Landing Gear MTBM Op Regression Data

LOG of Le	MTBM Op	MTBM Op	MTBM OP
2.04454	11.67016	11.67016	
2.451479	5.621607		5.621607
2.382017	3.768047		3.768047
2.537819	3.36902		3.36902
2.67256	2.408774		2.408774
2.32838	9.084168		9.084168
2.536306	15.40863		15.40863
2.362482	7.691049		7.691049
2.516271	7.588254		7.588254
2.475671	8.768538		8.768538
2.630428			
2.005609	7.176526	7.176526	
2.027757	9.164554	9.164554	
1.90309	9.774752	9.774752	
2.135133	6.532921	6.532921	
2.038223	15.51632	15.51632	
2.540329	13.15351		13.15351
2.426511	10.70634		10.70634
1.963316	18.75748	18.75748	
1.800029	11.26118	11.26118	
1.854913	6.858543	6.858543	
2.285557	11.10548	11.10548	
2.112605	3.527951	3.527951	

Appendix D
Landing Gear MTBM S Regression Data

Vehicle	Average G	Oleo Trav	Length + W	SQRT Avg	SQRT Ole	SQRT Len	LN Avg Gr	LN Oleo T	LN Length
A-10A	41428.5	15	110.8	203.5399	3.872983	10.52616	10.63172	2.70805	4.707727
B-1B	434358	16.5	282.8	659.0584	4.062019	16.81666	12.98162	2.80336	5.64474
B-2A	336500	18	241	580.0862	4.242641	15.52417	12.72635	2.890372	5.484797
B-52H	480400	18	345	693.1089	4.242641	18.57418	13.08237	2.890372	5.843544
C-5B	576910	25	470.5	759.5459	5	21.69101	13.26544	3.218876	6.153796
C-9A	88461	15	213	297.4239	3.872983	14.59452	11.39032	2.70805	5.361292
C-17A	414780	22.1	343.8	644.0342	4.701064	18.54184	12.9355	3.095578	5.84006
C-130H	118811	10.5	230.4	344.6897	3.24037	15.17893	11.68529	2.351375	5.439817
C141B	271197	28	328.3	520.7658	5.291503	18.11905	12.5106	3.332205	5.793928
E-3A	325000	22	299	570.0877	4.690416	17.29162	12.69158	3.091042	5.700444
E-4B			427			20.66398			6.056784
F-4E	57000	15.9	101.3	238.7467	3.98748	10.06479	10.95081	2.766319	4.618086
F-15C	45688	9	106.6	213.7475	3	10.32473	10.72959	2.197225	4.669084
F-16C	28000	10.5	80	167.332	3.24037	8.944272	10.23996	2.351375	4.382027
F-111F	83000	17.87	136.5	288.0972	4.227292	11.68332	11.3266	2.883123	4.916325
F-117A	48000	9	109.2	219.089	3	10.44988	10.77896	2.197225	4.693181
KC-10A	514500	24	347	717.2866	4.898979	18.62794	13.15095	3.178054	5.849325
KC-135A	270000	22	267	519.6152	4.690416	16.34013	12.50618	3.091042	5.587249
T-1A	13772	8.5	91.9	117.3542	2.915476	9.586449	9.530393	2.140066	4.520701
T-37B	5736	8.5	63.1	75.73638	2.915476	7.943551	8.654517	2.140066	4.144721
T-38A	10471	11.5	71.6	102.3279	3.391165	8.461678	9.256365	2.442347	4.271095
T-43A	70320	14	193	265.1792	3.741657	13.89244	11.16081	2.639057	5.26269
U-2R	15850		129.6	125.8968		11.3842	9.670925		4.864453

Appendix D
Landing Gear MTBM S Regression Data

SQ Avg G	SQ Oleo T	SQ Length	LOG Avg (	LOG Oleo	LOG Leng	MTBM So	MTBM So	MTBM So	MTBM So
1.7E+009	225	12276.64	4.617299	1.176091	2.04454	6.401213	6.401213	6.401213	
1.9E+011	272.25	79975.84	5.637848	1.217484	2.451479	1.260981	1.260981		1.260981
1.1E+011	324	58081	5.526985	1.255273	2.382017	0.868977	0.868977		0.868977
2.3E+011	324	119025	5.681603	1.255273	2.537819	0.550698	0.550698		0.550698
3.3E+011	625	221370.3	5.761108	1.39794	2.67256	0.581715	0.581715		0.581715
7.8E+009	225	45369	4.946752	1.176091	2.32838	6.486031	6.486031		6.486031
1.7E+011	488.41	118198.4	5.617818	1.344392	2.536306	5.332441	5.332441		5.332441
1.4E+010	110.25	53084.16	5.074857	1.021189	2.362482	3.7492	3.7492		3.7492
7.4E+010	784	107780.9	5.433285	1.447158	2.516271	2.477104			2.477104
1.1E+011	484	89401	5.511883	1.342423	2.475671	1.176291	1.176291		1.176291
		182329			2.630428				
3.2E+009	252.81	10261.69	4.755875	1.201397	2.005609	5.949501	5.949501	5.949501	
2.1E+009	81	11363.56	4.659802	0.954243	2.027757	5.945826	5.945826	5.945826	
7.8E+008	110.25	6400	4.447158	1.021189	1.90309	6.665226	6.665226	6.665226	
6.9E+009	319.3369	18632.25	4.919078	1.252125	2.135133	2.852809	2.852809	2.852809	
2.3E+009	81	11924.64	4.681241	0.954243	2.038223	8.825562	8.825562	8.825562	
2.6E+011	576	120409	5.711385	1.380211	2.540329	2.896588	2.896588		2.896588
7.3E+010	484	71289	5.431364	1.342423	2.426511	2.648855	2.648855		2.648855
1.9E+008	72.25	8445.61	4.138997	0.929419	1.963316	7.977321	7.977321	7.977321	
32901696	72.25	3981.61	3.758609	0.929419	1.800029	8.792307	8.792307	8.792307	
1.1E+008	132.25	5126.56	4.019988	1.060698	1.854913	5.724767	5.724767	5.724767	
4.9E+009	196	37249	4.847079	1.146128	2.285557	4.066751	4.066751	4.066751	
2.5E+008		16796.16	4.200029		2.112605	1.621341	1.621341	1.621341	

Appendix D
Landing Gear MH/MA Regression Data

Vehicle	Oleo Exte	Hydraulic	Fuselage \	SQRT Ole	SQRT Hyd	SQRT Fus	LN Oleo E	LN Hydr S	LN Fuse V
A-10A	62.8		793	7.924645		28.16026	4.139955		6.675823
B-1B	130.1	167	9334	11.40614	12.92285	96.61263	4.868303	5.117994	9.141419
B-2A	96.6			9.82853			4.570579		
B-52H	62.7	80.3	12447	7.918333	8.961027	111.5661	4.138361	4.38577	9.429235
C-5B	80.8	282	86610	8.988882	16.79286	294.2958	4.391977	5.641907	11.36917
C-9A	48.2		7647	6.942622		87.44713	3.875359		8.942069
C-17A	50.1	240	38290	7.078135	15.49193	195.6783	3.914021	5.480639	10.55294
C-130H	57.65	18.9	9060	7.59276	4.347413	95.18403	4.05439	2.939162	9.111624
C141B	61.7		19700	7.854935		140.3567	4.122284		9.888374
E-3A	91	55	16002	9.539392	7.416198	126.499	4.51086	4.007333	9.680469
E-4B									
F-4E	61.8	23	1473	7.861298	4.795832	38.37968	4.123903	3.135494	7.295056
F-15C	50.1	22.9	1830	7.078135	4.785394	42.7785	3.914021	3.131137	7.512071
F-16C	49.9		774.93	7.063993		27.83756	3.910021		6.652773
F-111F		35	2089		5.91608	45.70558		3.555348	7.644441
F-117A	60		2280	7.745967		47.74935	4.094345		7.731931
KC-10A	131		41300	11.44552		203.224	4.875197		10.62862
KC-135A	91.9	43	11550	9.586449	6.557439	107.4709	4.520701	3.7612	9.354441
T-1A	32.53			5.703508			3.482163		
T-37B	31.711			5.631252			3.456664		
T-38A	49.1	5.19	489	7.007139	2.278157	22.11334	3.893859	1.646734	6.192362
T-43A	74.9	23.8	10231	8.654479	4.878524	101.1484	4.316154	3.169686	9.233178
U-2R									

Appendix D
Landing Gear MH/MA Regression Data

SQ Oleo E	SQ Hydr S	SQ Fuse V	LOG Oleo	LOG Hydr	LOG Fuse	MH/MA	MH/MA Ad	MH/MA Fu	MH/MA Fu
3943.84		628849	1.79796		2.899273	6.331456	6.331456	6.331456	
16926.01	27889	87123556	2.114277	2.222716	3.970068	6.939913	6.939913		6.939913
9331.56			1.984977			6.851902	6.851902		
3931.29	6448.09	1.5E+008	1.797268	1.904716	4.095065	4.695236	4.695236		4.695236
6528.64	79524	7.5E+009	1.907411	2.450249	4.937568	3.237465	3.237465		3.237465
2323.24		58476609	1.683047		3.883491	4.90623	4.90623	4.90623	
2510.01	57600	1.5E+009	1.699838	2.380211	4.583085	3.938662	3.938662		3.938662
3323.523	357.21	82083600	1.760799	1.276462	3.957128	4.954263	4.954263	4.954263	
3806.89		3.9E+008	1.790285		4.294466	4.355191	4.355191		4.355191
8281	3025	2.6E+008	1.959041	1.740363	4.204174	5.413527			5.413527
3819.24	529	2169729	1.790988	1.361728	3.168203	4.139789	4.139789	4.139789	
2510.01	524.41	3348900	1.699838	1.359835	3.262451	6.045304	6.045304	6.045304	
2490.01		600516.5	1.698101		2.889262	6.798574	6.798574	6.798574	
	1225	4363921		1.544068	3.319938	7.269354	7.269354	7.269354	
3600		5198400	1.778151		3.357935	7.251082	7.251082	7.251082	
17161		1.7E+009	2.117271		4.61595	3.411079	3.411079		3.411079
8445.61	1849	1.3E+008	1.963316	1.633468	4.062582	10.20176	10.20176		10.20176
1058.201			1.512284			4.334607	4.334607		
1005.588			1.50121			3.335344	3.335344		
2410.81	26.9361	239121	1.691081	0.715167	2.689309	3.322172	3.322172	3.322172	
5610.01	566.44	1E+008	1.874482	1.376577	4.009918	6.190932	6.190932		6.190932
						4.916431	4.916431		

Appendix D
Landing Gear SMH/FLYHR Regression Data

Vehicle	Stall Spee	Weight of	Fuselage V	SQRT Sta	SQRT Wgt	SQRT Fus	LN Stall S	LN Wgt of	LN Fuse V
A-10A	91.5	1485.5	793	9.565563	38.54218	28.16026	4.516339	7.303507	6.675823
B-1B	126	16234.4	9334	11.22497	127.4143	96.61263	4.836282	9.694888	9.141419
B-2A		12852			113.3667			9.461255	
B-52H		13522	12447		116.2841	111.5661		9.512073	9.429235
C-5B	102	38282	86610	10.0995	195.6579	294.2958	4.624973	10.55274	11.36917
C-9A	99	4174	7647	9.949874	64.6065	87.44713	4.59512	8.33663	8.942069
C-17A	140	23184	38290	11.83216	152.2629	195.6783	4.941642	10.05122	10.55294
C-130H	100	5064	9060	10	71.16179	95.18403	4.60517	8.529912	9.111624
C141B	122	10850	19700	11.04536	104.1633	140.3567	4.804021	9.29192	9.888374
E-3A	108	12845	16002	10.3923	113.3358	126.499	4.682131	9.46071	9.680469
E-4B									
F-4E	118	1944	1473	10.86278	44.09082	38.37968	4.770685	7.572503	7.295056
F-15C		1399	1830		37.40321	42.7785		7.243513	7.512071
F-16C	108	1186.2	774.93	10.3923	34.44125	27.83756	4.682131	7.07851	6.652773
F-111F		2629.5	2089		51.27865	45.70558		7.874549	7.644441
F-117A	150	1741.7	2280	12.24745	41.73368	47.74935	5.010635	7.462617	7.731931
KC-10A	125	26353	41300	11.18034	162.3361	203.224	4.828314	10.17934	10.62862
KC-135A	101	10161	11550	10.04988	100.8018	107.4709	4.615121	9.226312	9.354441
T-1A	107	627.17		10.34408	25.04336		4.672829	6.441218	
T-37B	70	332.67		8.3666	18.23924		4.248495	5.807151	
T-38A	130	528.4	489	11.40175	22.98695	22.11334	4.867534	6.269854	6.192362
T-43A	102	4586	10231	10.0995	67.72001	101.1484	4.624973	8.430763	9.233178
U-2R									

Appendix D
Landing Gear SMH/FLYHR Regression Data

SQ Stall S	SQ Wgt of	SQ Fuse V	LOG Stall	LOG Wgt (	LOG Fuse	SMH/FLYH	SMH/FLYH	SMH/FLYH	SMH/FLYH
8372.25	2206710	628849	1.961421	3.171873	2.899273	0.100477	0.100477	0.100477	
15876	2.6E+008	87123556	2.100371	4.210436	3.970068	0.153578	0.153578		0.153578
	1.7E+008			4.108971		0.180052	0.180052		
	1.8E+008	1.5E+008		4.131041	4.095065	0.312736	0.312736		0.312736
10404	1.5E+009	7.5E+009	2.0086	4.582995	4.937568	0.292725	0.292725		0.292725
9801	17422276	58476609	1.995635	3.620552	3.883491	0.090247		0.090247	
19600	5.4E+008	1.5E+009	2.146128	4.365188	4.583085	0.033452	0.033452		0.033452
10000	25644096	82083600	2	3.704494	3.957128	0.297136	0.297136	0.297136	
14884	1.2E+008	3.9E+008	2.08636	4.03543	4.294466	0.143128	0.143128		0.143128
11664	1.6E+008	2.6E+008	2.033424	4.108734	4.204174	0.141011	0.141011		0.141011
13924	3779136	2169729	2.071882	3.288696	3.168203	0.127427	0.127427	0.127427	
	1957201	3348900		3.145818	3.262451	0.075161	0.075161	0.075161	
11664	1407070	600516.5	2.033424	3.074158	2.889262	0.087628	0.087628	0.087628	
	6914270	4363921		3.419873	3.319938	0.144635	0.144635	0.144635	
22500	3033519	5198400	2.176091	3.240973	3.357935	0.013746		0.013746	
15625	6.9E+008	1.7E+009	2.09691	4.42083	4.61595	0.037863	0.037863		0.037863
10201	1E+008	1.3E+008	2.004321	4.006936	4.062582	0.099171			0.099171
11449	393342.2		2.029384	2.797385		0.065411	0.065411		
4900	110669.3		1.845098	2.522014		0.164491	0.164491		
16900	279206.6	239121	2.113943	2.722963	2.689309	0.121765	0.121765	0.121765	
10404	21031396	1E+008	2.0086	3.661434	4.009918	0.164685	0.164685		0.164685
						0.853537	0.853537		

Appendix D
Landing Gear AVG CREW Regression Data

Vehicle	Maximum	Oleo Exte	WUC 45	SQRT Max	SQRT Ole	SQRT WU	LN Max D	LN Oleo E	LN WUC 4
A-10A	33245	62.8	373.2	182.3321	7.924645	19.31839	10.41166	4.139955	5.922114
B-1B	263328	130.1	2701.9	513.1549	11.40614	51.9798	12.48116	4.868303	7.901711
B-2A		96.6	4649		9.82853	68.18358		4.570579	8.444407
B-52H	270000	62.7	2024	519.6152	7.918333	44.98889	12.50618	4.138361	7.612831
C-5B	635850	80.8	4483.7	797.402	8.988882	66.96044	13.36272	4.391977	8.408204
C-9A	99000	48.2	752	314.6427	6.942622	27.42262	11.50288	3.875359	6.622736
C-17A	580000	50.1	5187	761.5773	7.078135	72.02083	13.27078	3.914021	8.553911
C-130H	130000	57.65	666	360.5551	7.59276	25.80698	11.77529	4.05439	6.50129
C141B	323100	61.7	1605	568.4189	7.854935	40.06245	12.68572	4.122284	7.380879
E-3A	250000	91	796	500	9.539392	28.21347	12.42922	4.51086	6.679599
E-4B									
F-4E	46000	61.8	543	214.4761	7.861298	23.30236	10.7364	4.123903	6.297109
F-15C	35000	50.1	437	187.0829	7.078135	20.90454	10.4631	3.914021	6.079933
F-16C	31000	49.9	310.3	176.0682	7.063993	17.61533	10.34174	3.910021	5.73754
F-111F	82500		646	287.2281		25.41653	11.32055		6.4708
F-117A		60	1206.9		7.745967	34.74047		4.094345	7.09581
KC-10A	436000	131	4166	660.303	11.44552	64.54456	12.9854	4.875197	8.334712
KC-135A	185000	91.9	865	430.1163	9.586449	29.41088	12.12811	4.520701	6.76273
T-1A	15700	32.53	152.46	125.2996	5.703508	12.34747	9.661416	3.482163	5.026902
T-37B	6097.8	31.711	52.58	78.08841	5.631252	7.251207	8.715683	3.456664	3.962336
T-38A	10770	49.1	147.2	103.7786	7.007139	12.1326	9.28452	3.893859	4.991792
T-43A	103000	74.9	568.1	320.9361	8.654479	23.83485	11.54248	4.316154	6.342297
U-2R									

Appendix D
Landing Gear AVG CREW Regression Data

SQ Max D	SQ Oleo E	SQ WUC 4	LOG Max I	LOG Oleo	LOG WUC	Avg Crew	Avg Crew	Avg Crew	Avg Crew
1.1E+009	3943.84	139278.2	4.521726	1.79796	2.571942	1.889987	1.889987	1.889987	
6.9E+010	16926.01	7300264	5.420497	2.114277	3.431669	2.203147	2.203147		2.203147
	9331.56	21613201		1.984977	3.66736	1.827174	1.827174		
7.3E+010	3931.29	4096576	5.431364	1.797268	3.306211	2.794783	2.794783		2.794783
4E+011	6528.64	20103566	5.803355	1.907411	3.651637	2.398122			2.398122
9.8E+009	2323.24	565504	4.995635	1.683047	2.876218	2.637758	2.637758	2.637758	
3.4E+011	2510.01	26904969	5.763428	1.699838	3.714916				
1.7E+010	3323.523	443556	5.113943	1.760799	2.823474				
1E+011	3806.89	2576025	5.509337	1.790285	3.205475	1.756125	1.756125		1.756125
6.3E+010	8281	633616	5.39794	1.959041	2.900913	2.098266	2.098266		2.098266
2.1E+009	3819.24	294849	4.662758	1.790988	2.7348	3.043963	3.043963	3.043963	
1.2E+009	2510.01	190969	4.544068	1.699838	2.640481	2.605734	2.605734	2.605734	
9.6E+008	2490.01	96286.09	4.491362	1.698101	2.491782				
6.8E+009		417316	4.916454		2.810233	3.2598	3.2598	3.2598	
	3600	1456608		1.778151	3.081671	3.112053	3.112053		
1.9E+011	17161	17355556	5.639486	2.117271	3.619719	1.586548	1.586548		1.586548
3.4E+010	8445.61	748225	5.267172	1.963316	2.937016	5.100878	5.100878		5.100878
2.5E+008	1058.201	23244.05	4.1959	1.512284	2.183156	4.208356	4.208356	4.208356	
37183165	1005.588	2764.656	3.785173	1.50121	1.720821	4.388611	4.388611	4.388611	
1.2E+008	2410.81	21667.84	4.032216	1.691081	2.167908				
1.1E+010	5610.01	322737.6	5.012837	1.874482	2.754425	2.399586	2.399586	2.399586	
						1.862284	1.862284		

APPENDIX E

Correlation Report

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Pearson Correlations Section (Pair-Wise Deletion)

	Wgt Empty	Avg Gross Wgt	Max Payload	Max Land Wgt	LimitLandSinkSpd	Stall Spd Ld Confi
Weight Empty	1.000000	0.952648	0.936864	0.982946	-0.391407	0.245332
Avg Gross Wgt	0.952648	1.000000	0.844766	0.910917	-0.406976	0.261762
Max Payload	0.936864	0.844766	1.000000	0.947499	-0.431316	0.134119
MaxDesignLandWt	0.982946	0.910917	0.947499	1.000000	-0.462081	0.445197
LimitLandSinkSpd	-0.391407	-0.406976	-0.431316	-0.462081	1.000000	-0.219265
Stall Spd Ld Config	0.245332	0.261762	0.134119	0.445197	-0.219265	1.000000
LND Grd Roll	0.142796	0.179577	0.183114	0.170231	-0.313593	0.449929
TO Grd Roll	0.527314	0.847839	0.782483	0.776282	-0.567546	0.266955
Wt of Gear Group	0.985971	0.933435	0.960843	0.965378	-0.343611	0.206665
Oleo Ext N/W	0.443221	0.568359	0.225376	0.403277	-0.032623	0.442694
Oleo Ext Main	0.560297	0.678896	0.473368	0.467332	-0.158818	0.242032
Oleo Travel N/W	0.634237	0.646439	0.524799	0.587191	-0.210945	0.344438
Oleo Travel Main	0.775020	0.774193	0.774140	0.795403	-0.664276	0.189185
Number of Wheels	0.889018	0.844023	0.958518	0.923089	-0.418212	0.082279
Hydr System Cap	0.944901	0.835438	0.887533	0.951905	-0.349567	0.277128
WUC45	0.876199	0.836004	0.773069	0.950511	-0.300938	0.430907
Length+Wingspan	0.907850	0.936543	0.888013	0.926108	-0.585791	0.169405
Fuselage Volume	0.910180	0.773069	0.963835	0.904226	-0.302758	-0.012801
MTBM op/fail	-0.235586	-0.287736	-0.215557	-0.161350	0.114065	0.173410
MTBM sortie/fail	-0.629262	-0.709152	-0.595791	-0.625106	0.482741	-0.063416
MH/MA unsch/fail	-0.236587	-0.124048	-0.215186	-0.275049	-0.042773	0.015618
SMH/FLYHRsch/op	-0.033713	-0.031650	0.237846	0.168100	-0.187107	-0.479444
AvgCrewsizeav/aq	-0.385986	-0.330769	-0.240525	-0.431303	0.102163	-0.339993

Cronbachs Alpha = 0.737085 Standardized Cronbachs Alpha = 0.867462

Correlation Report

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Pearson Correlations Section (Pair-Wise Deletion)

	LND Grd Roll	TO Grd Roll	Wgt of Gear Group	Oleo Ext N/W	Oleo Ext Main	Oleo Travel N/W
Weight Empty	0.142796	0.527314	0.985971	0.443221	0.560297	0.634237
Avg Gross Wgt	0.179577	0.847839	0.933435	0.568359	0.678896	0.646439
Max Payload	0.183114	0.782483	0.960843	0.225376	0.473368	0.524799
MaxDesignLandWt	0.170231	0.776282	0.965378	0.403277	0.467332	0.587191
LimitLandSinkSpd	-0.313593	-0.567546	-0.343611	-0.032623	-0.158818	-0.210945
Stall Spd Ld Config	0.449929	0.266955	0.206665	0.442694	0.242032	0.344438
LND Grd Roll	1.000000	0.326441	0.138379	-0.378778	0.321991	-0.148082
TO Grd Roll	0.326441	1.000000	0.796836	0.230655	0.629651	0.418764
Wt of Gear Group	0.138379	0.796836	1.000000	0.414446	0.580608	0.596202
Oleo Ext N/W	-0.378778	0.230655	0.414446	1.000000	0.706318	0.681533
Oleo Ext Main	0.321991	0.629651	0.580608	0.706318	1.000000	0.465493
Oleo Travel N/W	-0.148082	0.418764	0.596202	0.681533	0.465493	1.000000
Oleo Travel Main	0.209490	0.655300	0.750946	0.284403	0.551646	0.530299
Number of Wheels	0.164646	0.648440	0.957560	0.264440	0.453771	0.563055
Hydr System Cap	-0.195180	0.647932	0.945342	0.407388	0.263285	0.620125
WUC45	0.085918	0.687690	0.864132	0.642001	0.523024	0.615457
Length+Wingspan	0.213620	0.759188	0.913279	0.377858	0.556974	0.573528
Fuselage Volume	0.085699	0.707163	0.942487	0.103524	0.314127	0.434338
MTBM op/fail	-0.106047	-0.051881	-0.279151	-0.278626	-0.298671	-0.382428
MTBM sortie/fail	-0.323010	-0.480952	-0.653765	-0.457509	-0.698929	-0.512569
MH/MA unsch/fail	-0.020541	0.028498	-0.266503	0.185706	0.280897	0.034391
SMH/FLYHRsch/op	0.084284	-0.196812	0.264524	-0.013243	0.059023	0.128656
AvgCrewsizeav/aq	0.139174	0.120710	-0.392584	-0.511939	-0.445456	-0.319616

Cronbachs Alpha = 0.737085 Standardized Cronbachs Alpha = 0.867462

Correlation Report

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Pearson Correlations Section (Pair-Wise Deletion)

	Oleo Travel Main	Number of Wheels	Hydr System Cap	WUC45	Length+Wingspan	Fuselage Volume
Weight Empty	0.775020	0.889018	0.944901	0.876199	0.907850	0.910180
Avg Gross Wgt	0.774193	0.844023	0.835438	0.836004	0.936543	0.773069
Max Payload	0.774140	0.958518	0.887533	0.773069	0.888013	0.963835
MaxDesignLandWt	0.795403	0.923089	0.951905	0.950511	0.926108	0.904226
LimitLandSinkSpd	-0.664276	-0.418212	-0.349567	-0.300938	-0.585791	-0.302758
Stall Spd Ld Config	0.189185	0.082279	0.277128	0.430907	0.169405	-0.012801
LND Grd Roll	0.209490	0.164646	-0.195180	0.085918	0.213620	0.085699
TO Grd Roll	0.655300	0.648440	0.647932	0.687690	0.759188	0.707163
Wt of Gear Group	0.750946	0.957560	0.945342	0.864132	0.913279	0.942487
Oleo Ext N/W	0.284403	0.264440	0.407388	0.642001	0.377858	0.103524
Oleo Ext Main	0.551646	0.453771	0.263285	0.523024	0.556974	0.314127
Oleo Travel N/W	0.530299	0.563055	0.620125	0.615457	0.573528	0.434338
Oleo Travel Main	1.000000	0.739468	0.668443	0.613928	0.830670	0.657686
Number of Wheels	0.739468	1.000000	0.881515	0.771955	0.906957	0.959177
Hydr System Cap	0.668443	0.881515	1.000000	0.974208	0.809448	0.860438
WUC45	0.613928	0.771955	0.974208	1.000000	0.751354	0.825947
Length+Wingspan	0.830670	0.906957	0.809448	0.751354	1.000000	0.823448
Fuselage Volume	0.657686	0.959177	0.860438	0.825947	0.823448	1.000000
MTBM op/fail	-0.315054	-0.370282	-0.080342	-0.190431	-0.292974	-0.184093
MTBM sortie/fail	-0.722921	-0.652083	-0.394293	-0.525130	-0.721888	-0.492113
MH/MA unsch/fail	-0.067068	-0.230763	-0.308250	-0.193170	-0.146491	-0.472502
SMH/FLYHRsch/op	0.145370	0.196775	0.110014	0.089401	0.050119	0.278685
AvgCrewsizeav/aq	-0.407736	-0.277072	-0.313866	-0.510051	-0.359594	-0.242984

Cronbachs Alpha = 0.737085   Standardized Cronbachs Alpha = 0.867462

Correlation Report

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Pearson Correlations Section (Pair-Wise Deletion)

	MTBM op/fail	MTBM sortie/fail	MH/MA unsch/fail	SMH/FLYHRsch/op	AvgCrewsizeav/aq
Weight Empty	-0.235586	-0.629262	-0.236587	-0.033713	-0.385986
Avg Gross Wgt	-0.287736	-0.709152	-0.124048	-0.031650	-0.330769
Max Payload	-0.215557	-0.595791	-0.215186	0.237846	-0.240525
MaxDesignLandWt	-0.161350	-0.625106	-0.275049	0.168100	-0.431303
LimitLandSinkSpd	0.114065	0.482741	-0.042773	-0.187107	0.102163
Stall Spd Ld Config	0.173410	-0.063416	0.015618	-0.479444	-0.339993
LND Grd Roll	-0.106047	-0.323010	-0.020541	0.084284	0.139174
TO Grd Roll	-0.051881	-0.480952	0.028498	-0.196812	0.120710
Wt of Gear Group	-0.279151	-0.653765	-0.266503	0.264524	-0.392584
Oleo Ext N/W	-0.278626	-0.457509	0.185706	-0.013243	-0.511939
Oleo Ext Main	-0.298671	-0.698929	0.280897	0.059023	-0.445456
Oleo Travel N/W	-0.382428	-0.512569	0.034391	0.128656	-0.319616
Oleo Travel Main	-0.315054	-0.722921	-0.067068	0.145370	-0.407736
Number of Wheels	-0.370282	-0.652083	-0.230763	0.196775	-0.277072
Hydr System Cap	-0.080342	-0.394293	-0.308250	0.110014	-0.313866
WUC45	-0.190431	-0.525130	-0.193170	0.089401	-0.510051
Length+Wingspan	-0.292974	-0.721888	-0.146491	0.050119	-0.359594
Fuselage Volume	-0.184093	-0.492113	-0.472502	0.278685	-0.242984
MTBM op/fail	1.000000	0.709732	0.033309	-0.590683	0.402597
MTBM sortie/fail	0.709732	1.000000	-0.099004	-0.454504	0.447347
MH/MA unsch/fail	0.033309	-0.099004	1.000000	-0.140153	0.297285
SMH/FLYHRsch/op	-0.590683	-0.454504	-0.140153	1.000000	-0.247181
AvgCrewsizeav/aq	0.402597	0.447347	0.297285	-0.247181	1.000000

Cronbachs Alpha = 0.737085 Standardized Cronbachs Alpha = 0.867462

APPENDIX F

Multiple Regression Report

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Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	20.37083	112.5514	0.1810	0.859166	Accept Ho	0.053241
OleoTravelNoseorWing	49.87897	23.69745	2.1048	0.055326	Accept Ho	0.495526
Oleo Travel Main	-63.37007	23.11542	-2.7415	0.016810	Reject Ho	0.717391
SQRT of Oleo T N,W	-773.0554	357.253	-2.1639	0.049679	Reject Ho	0.517239
SQRT of Oleo T M	1030.119	367.3005	2.8046	0.014899	Reject Ho	0.736685
LN of Oleo T N, W	729.6061	329.768	2.2125	0.045443	Reject Ho	0.535066
LN of Oleo T M	-1024.592	356.9872	-2.8701	0.013140	Reject Ho	0.755983
LN of Length+Wing	-1.471395	2.414762	-0.6093	0.552804	Accept Ho	0.087369
R-Squared	0.557129					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	20.37083	112.5514	-222.7816	263.5233	0.0000
OleoTravelNoseorWing	49.87897	23.69745	-1.316257	101.0742	58.9638
Oleo Travel Main	-63.37007	23.11542	-113.3079	-13.43224	-90.5305
SQRT of Oleo T N,W	-773.0554	357.253	-1544.854	-1.257267	-120.1087
SQRT of Oleo T M	1030.119	367.3005	236.6144	1823.623	184.0311
LN of Oleo T N, W	729.6061	329.768	17.18558	1442.026	61.1606
LN of Oleo T M	-1024.592	356.9872	-1795.816	-253.3681	-94.1061
LN of Length+Wing	-1.471395	2.414762	-6.688171	3.745381	-0.2178
T-Critical	2.160369				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	1817.887	1817.887			
Model	7	192.7495	27.53565	2.3363	0.088492	0.112306
Error	13	153.2197	11.78613			
Total(Adjusted)	20	345.9693	17.29846			

Root Mean Square Error	3.433094	R-Squared	0.5571
Mean of Dependent	9.304088	Adj R-Squared	0.3187
Coefficient of Variation	0.3689877	Press Value	317.6587
Sum |Press Residuals|	70.13658	Press R-Squared	0.0818

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Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	1.4414	0.149462	Accepted
Kurtosis	0.3904	0.696219	Accepted
Omnibus	2.2302	0.327888	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	0.158608	9	-0.033080	17	-0.048757
2	-0.277584	10	0.377633	18	
3	-0.332953	11	0.094086	19	
4	-0.185808	12	-0.095330	20	
5	0.279890	13	-0.148181	21	
6	0.016037	14	-0.122823	22	
7	-0.122480	15	0.149701	23	
8	-0.193682	16	0.039042	24	

Above serial correlations significant if their absolute values are greater than 0.436436

Durbin-Watson Value 1.6328

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	11.67016	10.41736	3.887902	2.018054	18.81666
2	5.621607	4.696082	3.832838	-3.584262	12.97643
3	3.768047	7.469136	3.68609	-0.494178	15.43245
4	3.36902	6.165365	3.802408	-2.049237	14.37997
5	2.408773	6.253193	4.015028	-2.420749	14.92714
6	9.084168	4.657848	3.899545	-3.766606	13.0823
7	15.40863	8.87851	3.85423	0.5519514	17.20507
8	7.691049	10.06796	4.232804	0.9235445	19.21238
9	7.588253	7.817824	4.552941	-2.018207	17.65385
10	8.768538	11.20899	3.822313	2.951389	19.4666
11					
12	7.176526	7.861693	4.538847	-1.94389	17.66728
13	9.164555	10.45352	4.301167	1.161416	19.74563
14	9.774752	11.45728	3.819628	3.205474	19.70908
15	6.532921	9.393136	3.88699	0.9958045	17.79047
16	15.51632	13.50156	4.026314	4.803236	22.19988
17	13.15351	8.887635	3.752595	0.7806468	16.99462
18	10.70634	11.37555	3.830303	3.100683	19.65042
19	18.75748	17.80004	4.238613	8.64307	26.957
20	11.26118	11.6763	4.443564	2.076563	21.27604
21	6.858543	5.897985	4.23491	-3.250983	15.04695
22	11.10548	9.448874	3.885675	1.054383	17.84336

Multiple Regression Report

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Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	11.67016	10.41736	1.252799	10.74	12.58602
2	5.621607	4.696082	0.9255252	16.46	12.67358
3	3.768047	7.469136	-3.701088	98.22	11.4209
4	3.36902	6.165365	-2.796345	83.00	11.92563
5	2.408773	6.253193	-3.844419	159.60	10.82031
6	9.084168	4.657848	4.42632	48.73	10.4681
7	15.40863	8.87851	6.530118	42.38	7.963717
8	7.691049	10.06796	-2.376913	30.90	11.78716
9	7.588253	7.817824	-0.2295703	3.03	12.7501
10	8.768538	11.20899	-2.440457	27.83	12.1156
11					
12	7.176526	7.861693	-0.6851667	9.55	12.61312
13	9.164555	10.45352	-1.288968	14.06	12.44659
14	9.774752	11.45728	-1.682526	17.21	12.45878
15	6.532921	9.393136	-2.860214	43.78	11.81894
16	15.51632	13.50156	2.01476	12.98	12.22669
17	13.15351	8.887635	4.265874	32.43	10.88498
18	10.70634	11.37555	-0.6692139	6.25	12.71889
19	18.75748	17.80004	0.9574453	5.10	12.60771
20	11.26118	11.6763	-0.4151244	3.69	12.72408
21	6.858543	5.897985	0.9605587	14.01	12.60757
22	11.10548	9.448874	1.656605	14.92	12.45022

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
Oleo Travel NoseorWing	23035.902240	0.999957	0.000043	47.6466
Oleo Travel Main	32010.383216	0.999969	0.000031	45.33487
SQRT of Oleo T N,W	90436.842810	0.999989	0.000011	10828.8
SQRT of Oleo T M	126391.216183	0.999992	0.000008	11446.47
LN of Oleo T N, W	22431.074732	0.999955	0.000045	9226.687
LN of Oleo T M	31557.677314	0.999968	0.000032	10812.7
LN of Length+Wing	3.748711	0.733242	0.266758	0.4947404

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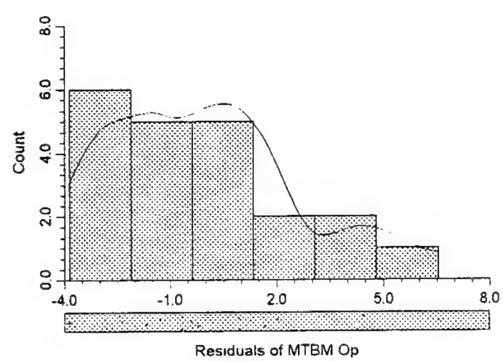
Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	5.416663	77.38	77.38	1.00
2	1.310455	18.72	96.10	4.13
3	0.250152	3.57	99.68	21.65
4	0.013329	0.19	99.87	406.39
5	0.009381	0.13	100.00	577.39
6	0.000017	0.00	100.00	315589.04
7	0.000004	0.00	100.00	1448511.18

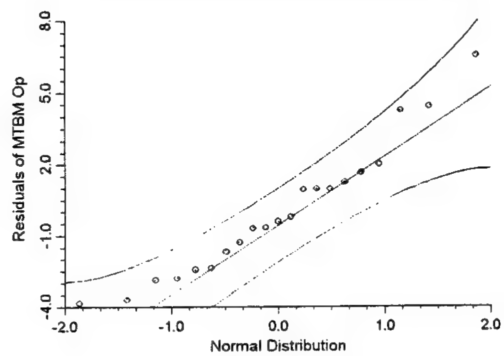
Some Condition Numbers greater than 1000. Multicollinearity is a SEVERE problem.

Plots Section

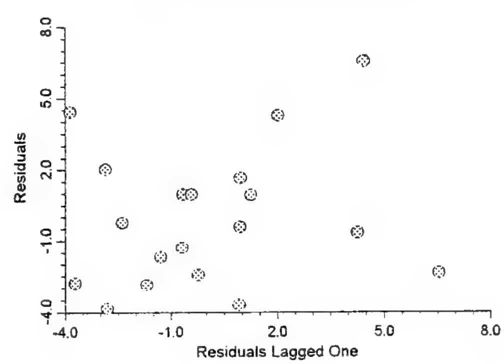
Histogram



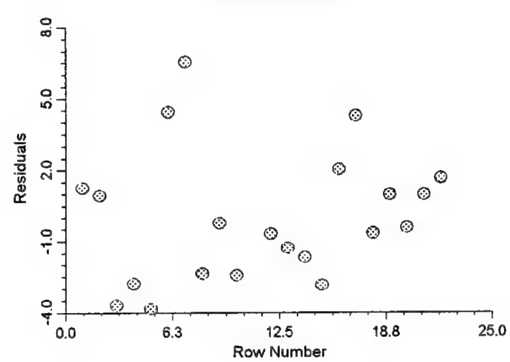
Normal Probability Plot of Residuals of MTBM Op



Serial Correlation of Residuals



Residual vs Row



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Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	26.32477	8.352202	3.1518	0.006171	Reject Ho	0.840874
SQRT Avg Gross Wgt	-9.372951E-03	2.819139E-03	-3.3248	0.004290	Reject Ho	0.876912
SQRT Oleo T M	13.28845	6.96674	1.9074	0.074582	Accept Ho	0.433719
LOG Oleo T M	-59.99788	29.57861	-2.0284	0.059502	Accept Ho	0.478652
R-Squared	0.758666					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	26.32477	8.352202	8.618887	44.03064	0.0000
SQRT Avg Gross Wgt	-9.372951E-03	2.819139E-03	-1.534926E-02	-3.396643E-03	-0.7907
SQRT Oleo T M	13.28845	6.96674	-1.480374	28.05728	3.3695
LOG Oleo T M	-59.99788	29.57861	-122.7017	2.705972	-3.4633
T-Critical	2.119905				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	393.8553	393.8553			
Model	3	108.4247	36.14157	16.7661	0.000034	0.872770
Error	16	34.49018	2.155637			
Total(Adjusted)	19	142.9149	7.521836			

Root Mean Square Error	1.468209	R-Squared	0.7587
Mean of Dependent	4.437653	Adj R-Squared	0.7134
Coefficient of Variation	0.3308525	Press Value	50.37255
Sum |Press Residuals|	26.41935	Press R-Squared	0.6475

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Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	1.6718	0.094564	Accepted
Kurtosis	0.4208	0.673892	Accepted
Omnibus	2.9720	0.226276	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	-0.044059	9	-0.031407	17	0.009768
2	-0.220956	10	0.297422	18	
3	-0.233107	11	0.032656	19	
4	-0.220640	12	-0.056447	20	
5	0.330517	13	-0.016165	21	
6	-0.012227	14	-0.128818	22	
7	-0.029806	15	-0.051320	23	
8	-0.150581	16	0.027146	24	

Above serial correlations significant if their absolute values are greater than 0.447214

Durbin-Watson Value 2.0224

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	6.401214	5.319974	1.60292	1.921935	8.718013
2	1.260981	1.078942	1.710016	-2.54613	4.704014
3	0.8689772	1.952092	1.572559	-1.381584	5.285768
4	0.5506985	0.892735	1.671047	-2.649725	4.435195
5	0.5817146	1.774411	1.701107	-1.831775	5.380597
6	6.486031	4.440003	1.559434	1.134151	7.745856
7	5.332441	2.097447	1.56477	-1.219718	5.414611
8	3.7492	4.884325	1.597309	1.49818	8.270469
9		4.933128	2.201932	0.2652395	9.601016
10	1.176291	2.76722	1.568036	-0.556868	6.091307
11					
12	5.949501	4.993173	1.597965	1.605638	8.380708
13	5.945827	6.934155	1.600446	3.541361	10.32695
14	6.665226	6.54669	1.540813	3.280313	9.813066
15	2.852809	4.673804	1.605067	1.271213	8.076395
16	8.825562	6.884089	1.602025	3.487948	10.28023
17	2.896589	1.891788	1.640424	-1.585755	5.36933
18	2.648855	3.240296	1.587578	-0.1252188	6.60581
19	7.977322	8.203814	1.643106	4.720583	11.68704
20	8.792307	8.593895	1.653303	5.089049	12.09874
21	5.724767	6.789369	1.576331	3.447697	10.13104
22	4.066751	4.794843	1.559174	1.489543	8.100143

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Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	6.401214	5.319974	1.081239	16.89	2.202896
2	1.260981	1.078942	0.1820389	14.44	2.295913
3	0.8689772	1.952092	-1.083115	124.64	2.207637
4	0.5506985	0.892735	-0.3420365	62.11	2.288277
5	0.5817146	1.774411	-1.192696	205.03	2.155128
6	6.486031	4.440003	2.046027	31.55	1.979251
7	5.332441	2.097447	3.234995	60.67	1.491975
8	3.7492	4.884325	-1.135124	30.28	2.194128
9		4.933128			
10	1.176291	2.76722	-1.590929	135.25	2.103001
11					
12	5.949501	4.993173	0.9563276	16.07	2.224575
13	5.945827	6.934155	-0.988328	16.62	2.219125
14	6.665226	6.54669	0.118536	1.78	2.298303
15	2.852809	4.673804	-1.820995	63.83	2.024686
16	8.825562	6.884089	1.941473	22.00	1.988887
17	2.896589	1.891788	1.004801	34.69	2.209798
18	2.648855	3.240296	-0.5914407	22.33	2.271276
19	7.977322	8.203814	-0.2264917	2.84	2.294771
20	8.792307	8.593895	0.1984128	2.26	2.29576
21	5.724767	6.789369	-1.064602	18.60	2.210169
22	4.066751	4.794843	-0.7280924	17.90	2.258828

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
SQRT Avg Gross Wgt	3.749618	0.733306	0.266694	3.686867E-06
SQRT Oleo T M	206.896504	0.995167	0.004833	22.5156
LOG Oleo T M	193.270868	0.994826	0.005174	405.8635

Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	2.787823	92.93	92.93	1.00
2	0.209669	6.99	99.92	13.30
3	0.002508	0.08	100.00	1111.75

Some Condition Numbers greater than 1000. Multicollinearity is a SEVERE problem.

Multiple Regression Report

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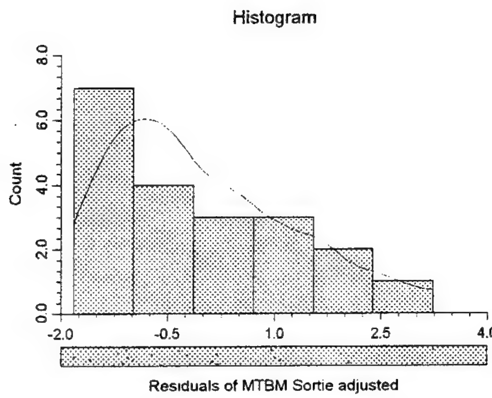
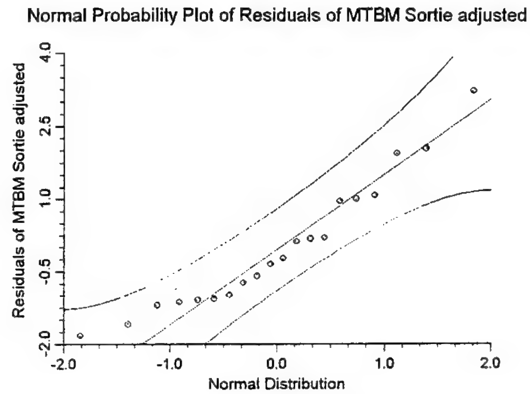
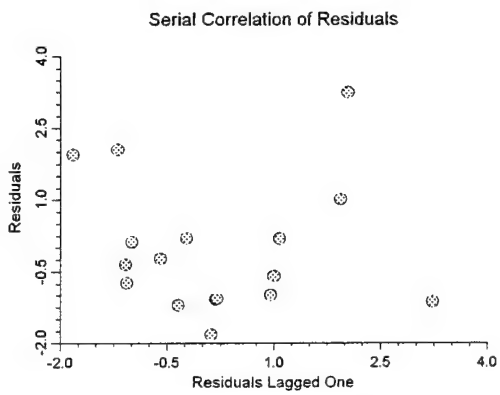
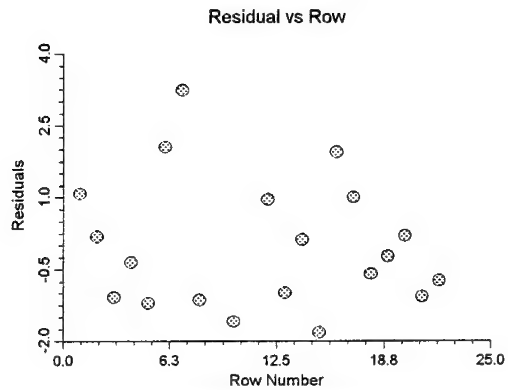
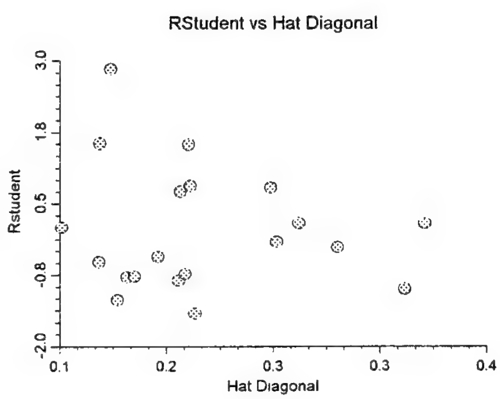
Plots Section

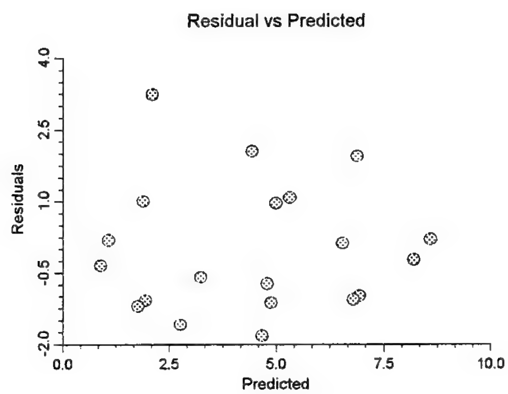












Multiple Regression Report

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Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	664.3605	259.1513	2.5636	0.028198	Reject Ho	0.638081
Oleo Extend Main	-6.929825	2.461836	-2.8149	0.018320	Reject Ho	0.718407
SQRT Oleo Ext M	243.2979	88.22218	2.7578	0.020206	Reject Ho	0.700923
SQRT Fuse Vol	-3.721993E-02	0.0119781	-3.1073	0.011111	Reject Ho	0.799341
LN Oleo Ext M	-521.1387	194.1641	-2.6840	0.022934	Reject Ho	0.677629
LN Fuse Vol	1.021577	0.5945361	1.7183	0.116495	Accept Ho	0.342797
R-Squared	0.697594					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	664.3605	259.1513	86.93536	1241.786	0.0000
Oleo Extend Main	-6.929825	2.461836	-12.41514	-1.444514	-99.2856
SQRT Oleo Ext M	243.2979	88.22218	46.72665	439.8692	189.7729
SQRT Fuse Vol	-3.721993E-02	0.0119781	-6.390879E-02	-1.053107E-02	-1.5196
LN Oleo Ext M	-521.1387	194.1641	-953.7633	-88.51417	-90.5969
LN Fuse Vol	1.021577	0.5945361	-0.3031316	2.346286	0.8576
T-Critical	2.228139				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	470.0127	470.0127			
Model	5	35.86897	7.173795	4.6136	0.019215	0.211781
Error	10	15.54915	1.554915			
Total(Adjusted)	15	51.41813	3.427875			

Root Mean Square Error	1.246962	R-Squared	0.6976
Mean of Dependent	5.419944	Adj R-Squared	0.5464
Coefficient of Variation	0.2300692	Press Value	40.07484
Sum |Press Residuals|	20.90317	Press R-Squared	0.2206

Multiple Regression Report

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Dependent	MH/MA Adj

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	-0.2649	0.791064	Accepted
Kurtosis	-0.4133	0.679359	Accepted
Omnibus	0.2410	0.886461	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	0.028685	9	0.231457	17	0.096747
2	0.106633	10	-0.101013	18	
3	-0.115731	11	-0.004382	19	
4	-0.119567	12	-0.017581	20	
5	-0.230167	13	0.111000	21	
6	-0.038077	14	-0.085814	22	
7	-0.134380	15	0.116880	23	
8	-0.200554	16	0.051788	24	

Above serial correlations significant if their absolute values are greater than 0.500000
Durbin-Watson Value 1.6616

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	6.331456	5.497806	1.444945	2.278267	8.717345
2	6.939913	6.561147	1.546432	3.115483	10.00681
3	6.851902				
4	4.695236	5.194068	1.375395	2.129498	8.258638
5	3.237464	3.238266	1.677594	-0.4996472	6.976179
6	4.906229	5.74883	1.481891	2.446972	9.050689
7	3.938662	3.021298	1.488198	-0.2946144	6.33721
8	4.954263	5.02427	1.367942	1.976306	8.072233
9	4.355191	4.475275	1.388008	1.3826	7.567948
10		9.057923	1.611062	5.468254	12.64759
11					
12	4.139789	5.632713	1.374125	2.570972	8.694454
13	6.045304	5.605731	1.35283	2.591439	8.620024
14	6.798574	5.313761	1.400927	2.192301	8.435222
15	7.269354				
16	7.251082	5.548429	1.348505	2.543773	8.553084
17	3.411078	3.864979	1.56887	0.3693195	7.360639
18	10.20176	9.516253	1.645803	5.849174	13.18333
19	4.334607				
20	3.335344				
21	3.322172	5.190503	1.483896	1.884177	8.496829
22	6.190932	7.285776	1.393853	4.180078	10.39147

Multiple Regression Report

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Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	6.331456	5.497806	0.8336502	13.17	1.610195
2	6.939913	6.561147	0.3787664	5.46	1.693181
3	6.851902				
4	4.695236	5.194068	-0.4988318	10.62	1.692391
5	3.237464	3.238266	-8.014889E-04	0.02	1.727683
6	4.906229	5.74883	-0.8426008	17.17	1.593456
7	3.938662	3.021298	0.9173643	23.29	1.565249
8	4.954263	5.02427	-7.000621E-02	1.41	1.727
9	4.355191	4.475275	-0.1200834	2.76	1.725578
10		9.057923			
11					
12	4.139789	5.632713	-1.492924	36.06	1.412469
13	6.045304	5.605731	0.4395725	7.27	1.701597
14	6.798574	5.313761	1.484813	21.84	1.39567
15	7.269354				
16	7.251082	5.548429	1.702654	23.48	1.33983
17	3.411078	3.864979	-0.4539005	13.31	1.672794
18	10.20176	9.516253	0.6855034	6.72	1.525306
19	4.334607				
20	3.335344				
21	3.322172	5.190503	-1.868331	56.24	1.063418
22	6.190932	7.285776	-1.094844	17.68	1.550225

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
Oleo Extend Main	41139.175910	0.999976	0.000024	3.897726
SQRT Oleo Ext M	156587.292616	0.999994	0.000006	5005.515
SQRT Fuse Vol	7.908462	0.873553	0.126447	9.227175E-05
LN Oleo Ext M	37676.245801	0.999973	0.000027	24245.5
LN Fuse Vol	8.238181	0.878614	0.121386	0.2273263

Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	3.666658	73.33	73.33	1.00
2	1.257034	25.14	98.47	2.92
3	0.066258	1.33	99.80	55.34
4	0.010047	0.20	100.00	364.97
5	0.000004	0.00	100.00	862776.17

Some Condition Numbers greater than 1000. Multicollinearity is a SEVERE problem.

Multiple Regression Report

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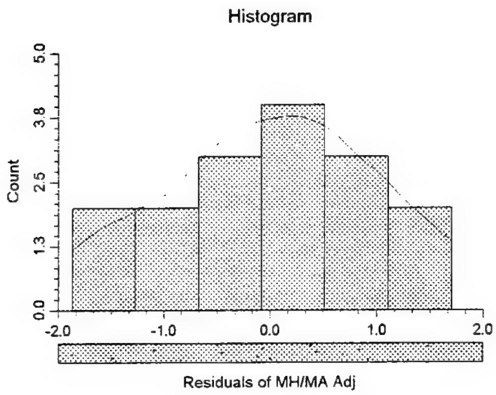
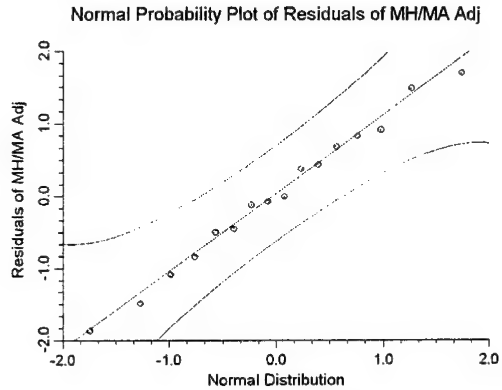
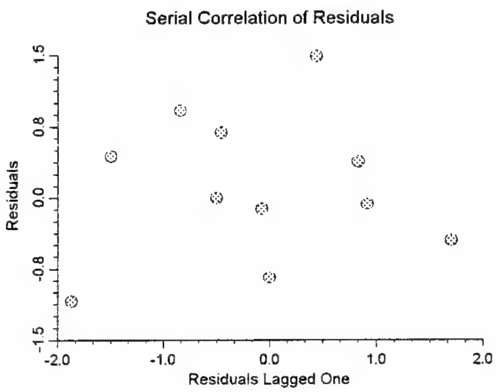
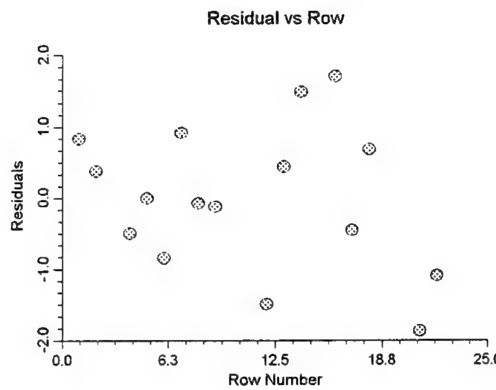
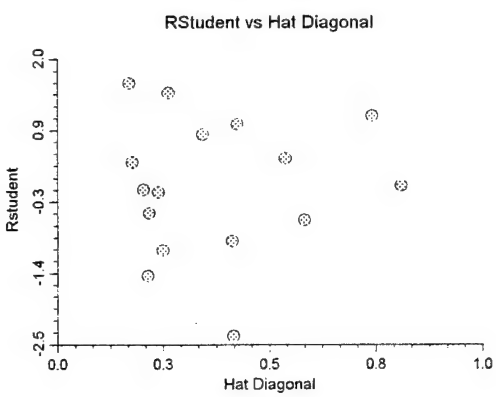
Plots Section

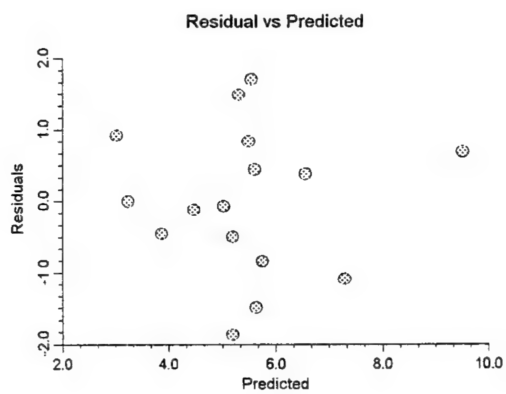












Multiple Regression Report

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Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	2.190422	0.6762304	3.2392	0.011893	Reject Ho	0.809100
Stall Speed Land Conf	-1.160511E-04	9.557808E-04	-0.1214	0.906353	Accept Ho	0.051328
Weight of Gear Group	-2.416306E-04	6.021928E-05	-4.0125	0.003881	Reject Ho	0.938061
SQRT Wgt of Gear Gp	4.635748E-02	1.262548E-02	3.6717	0.006294	Reject Ho	0.893732
LN Wgt of Gear Gp	-0.4802878	0.1547106	-3.1044	0.014568	Reject Ho	0.775896
SQ Wgt of Gear Gp	2.295069E-09	5.26218E-10	4.3614	0.002408	Reject Ho	0.966886
R-Squared	0.820314					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	2.190422	0.6762304	0.6310317	3.749812	0.0000
Stall Speed Land Conf	-1.160511E-04	9.557808E-04	-2.320086E-03	2.087983E-03	-0.0262
Weight of Gear Group	-2.416306E-04	6.021928E-05	-3.804965E-04	-1.027647E-04	-36.1839
SQRT Wgt of Gear Gp	4.635748E-02	1.262548E-02	1.724307E-02	7.547189E-02	34.2478
LN Wgt of Gear Gp	-0.4802878	0.1547106	-0.837051	-0.1235244	-9.6365
SQ Wgt of Gear Gp	2.295069E-09	5.26218E-10	1.081608E-09	3.50853E-09	12.0677
T-Critical	2.306004				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	0.2662785	0.2662785			
Model	5	6.685839E-02	1.337168E-02	7.3044	0.007456	0.292567
Error	8	1.464506E-02	1.830632E-03			
Total(Adjusted)	13	8.150345E-02	6.269496E-03			

Root Mean Square Error	4.278589E-02	R-Squared	0.8203
Mean of Dependent	0.1379126	Adj R-Squared	0.7080
Coefficient of Variation	0.3102391	Press Value	3.495878E-02
Sum |Press Residuals|	0.5454213	Press R-Squared	0.5711

Multiple Regression Report

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Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	1.6133	0.106669	Accepted
Kurtosis	1.4111	0.158224	Accepted
Omnibus	4.5940	0.100559	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	-0.286368	9	0.052881	17	-0.087427
2	-0.172953	10	0.086793	18	
3	0.068522	11	-0.211162	19	
4	0.034975	12	0.031618	20	
5	0.011581	13	0.249423	21	
6	0.229648	14	-0.246765	22	
7	-0.184505	15	0.007600	23	
8	-0.037992	16	-0.001175	24	

Above serial correlations significant if their absolute values are greater than 0.534522

Durbin-Watson Value 2.4577

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	0.1004767	0.1048592	5.147202E-02	-1.383555E-02	0.2235539
2	0.1535779	0.108219	4.765576E-02	-1.675389E-03	0.2181134
3	0.180052				
4	0.3127361				
5	0.2927249	0.2937868	6.015502E-02	0.1550691	0.4325045
6		0.2013651	4.808202E-02	9.048776E-02	0.3122424
7	3.345213E-02	3.685375E-02	5.051837E-02	-7.964183E-02	0.1533493
8	0.2971361	0.2161231	4.839476E-02	0.1045245	0.3277216
9	0.1431279	0.1907066	4.982122E-02	7.581864E-02	0.3055945
10	0.1410115	0.1629138	4.835011E-02	5.141822E-02	0.2744093
11					
12	0.1274271	0.1226299	0.0485579	1.065518E-02	0.2346046
13	7.516055E-02				
14	8.762839E-02	0.0913834	4.793953E-02	-1.916536E-02	0.2019322
15	0.1446348				
16		0.1095929	6.115459E-02	-0.0314298	0.2506157
17	3.786273E-02	3.858435E-02	5.198342E-02	-8.128963E-02	0.1584583
18		0.2020804	4.931825E-02	8.835227E-02	0.3158085
19	6.541104E-02	9.467288E-02	4.720735E-02	-1.418747E-02	0.2035332
20	0.1644908	0.1585909	5.822938E-02	2.431369E-02	0.292868
21	0.1217647	0.1025817	5.543545E-02	-2.525267E-02	0.2304161
22	0.1646849	0.2088717	4.805109E-02	0.0980657	0.3196777

Multiple Regression Report

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Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	0.1004767	0.1048592	-0.0043825	4.36	2.087187E-03
2	0.1535779	0.108219	4.535894E-02	29.53	1.705113E-03
3	0.180052				
4	0.3127361				
5	0.2927249	0.2937868	-1.061838E-03	0.36	2.085236E-03
6		0.2013651			
7	3.345213E-02	3.685375E-02	-3.401617E-03	10.17	2.089423E-03
8	0.2971361	0.2161231	8.101306E-02	27.26	7.910873E-04
9	0.1431279	0.1907066	-4.757868E-02	33.24	1.590071E-03
10	0.1410115	0.1629138	-2.190228E-02	15.53	1.997365E-03
11					
12	0.1274271	0.1226299	4.797209E-03	3.76	2.087534E-03
13	7.516055E-02				
14	8.762839E-02	0.0913834	-3.755007E-03	4.29	2.089446E-03
15	0.1446348				
16		0.1095929			
17	3.786273E-02	3.858435E-02	-7.216265E-04	1.91	2.092009E-03
18		0.2020804			
19	6.541104E-02	9.467288E-02	-2.926184E-02	44.74	1.935857E-03
20	0.1644908	0.1585909	5.899982E-03	3.59	2.05851E-03
21	0.1217647	0.1025817	1.918302E-02	15.75	1.928534E-03
22	0.1646849	0.2088717	-4.418683E-02	26.83	1.714582E-03

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse	
Stall Speed Landing Configuration		2.080803	0.519416	0.480584	4.990171E-04
Weight of Gear Group	3620.534938	0.999724	0.000276	1.980934E-06	
SQRT Wgt of Gear Gp	3873.427417	0.999742	0.000258	8.707522E-02	
LN Wgt of Gear Gp	428.989035	0.997669	0.002331	13.07492	
SQ Wgt of Gear Gp	340.852955	0.997066	0.002934	1.512622E-16	

Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	3.843231	76.86	76.86	1.00
2	0.895464	17.91	94.77	4.29
3	0.247368	4.95	99.72	15.54
4	0.013815	0.28	100.00	278.20
5	0.000122	0.00	100.00	31468.67

Some Condition Numbers greater than 1000. Multicollinearity is a SEVERE problem.

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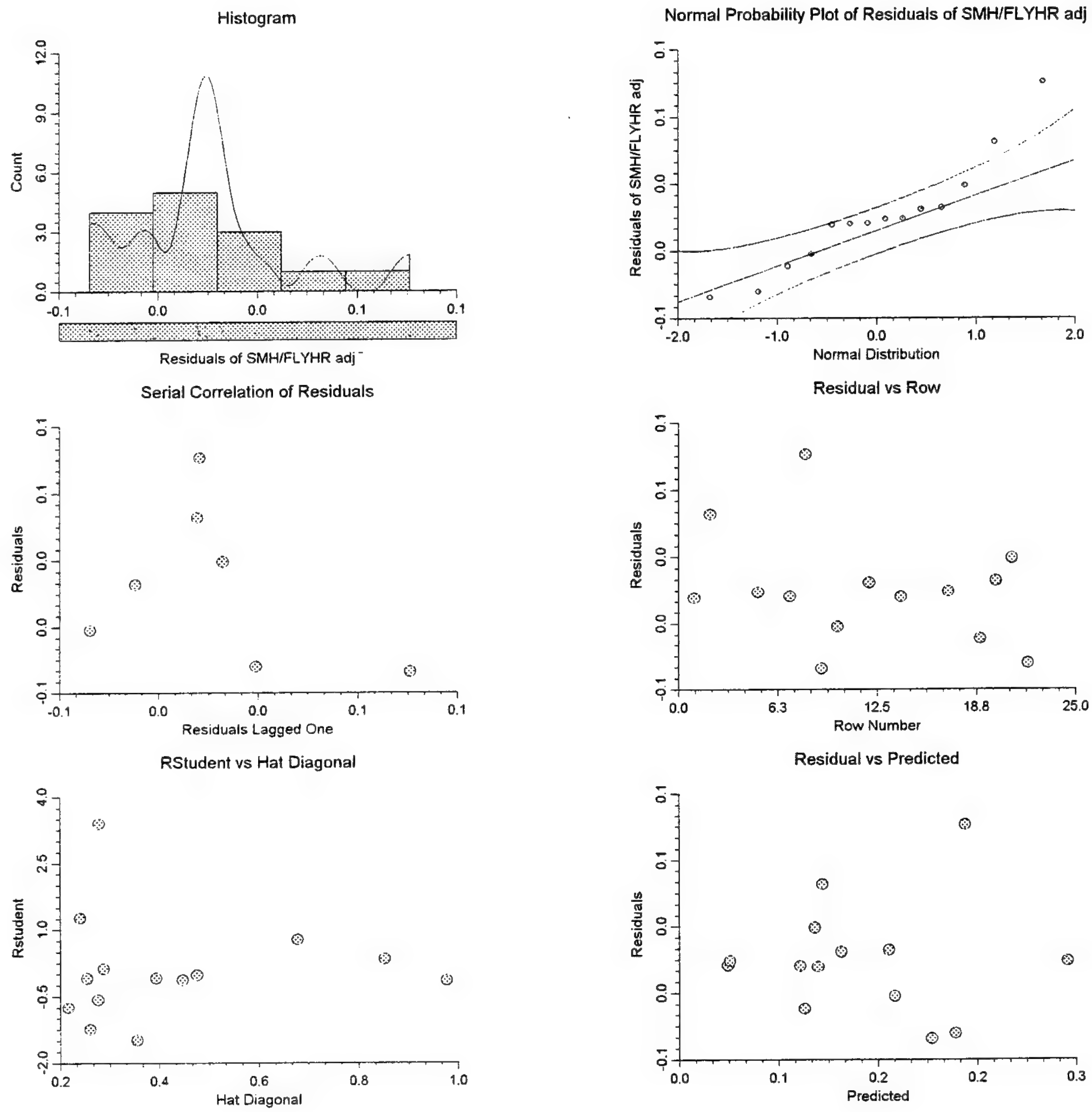
Plots Section



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Dependent	Avg Crew

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	130.4958	31.11983	4.1933	0.003024	Reject Ho	0.954804
Max Design Land Wght	-1.617608E-05	5.794453E-06	-2.7916	0.023498	Reject Ho	0.687281
Oleo Extend Main	3.888708	0.9774032	3.9786	0.004070	Reject Ho	0.934438
SQRT Oleo Ext M	-42.96297	10.68771	-4.0198	0.003842	Reject Ho	0.938825
SQRT WUC 45	0.1757128	6.883523E-02	2.5527	0.034034	Reject Ho	0.610699
SQ Oleo Ext M	-8.796215E-03	2.253986E-03	-3.9025	0.004529	Reject Ho	0.925703
R-Squared	0.777441					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	130.4958	31.11983	58.73332	202.2582	0.0000
Max Design Land Wght	-1.617608E-05	5.794453E-06	-2.953811E-05	-2.814049E-06	-2.8247
Oleo Extend Main	3.888708	0.9774032	1.634813	6.142604	113.3507
SQRT Oleo Ext M	-42.96297	10.68771	-67.60886	-18.31707	-72.4594
SQRT WUC 45	0.1757128	6.883523E-02	1.697845E-02	0.3344471	3.0520
SQ Oleo Ext M	-8.796215E-03	2.253986E-03	-1.399392E-02	-3.598514E-03	-43.1499
T-Critical	2.306004				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	109.267	109.267			
Model	5	11.26124	2.252248	5.5891	0.016510	0.228725
Error	8	3.223768	0.4029709			
Total(Adjusted)	13	14.48501	1.114231			

Root Mean Square Error	0.6347999	R-Squared	0.7774
Mean of Dependent	2.793705	Adj R-Squared	0.6383
Coefficient of Variation	0.2272251	Press Value	10.3115
Sum |Press Residuals|	9.651288	Press R-Squared	0.2881

Multiple Regression Report

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Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	1.5264	0.126921	Accepted
Kurtosis	1.2406	0.214750	Accepted
Omnibus	3.8689	0.144506	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	-0.147640	9	0.202451	17	-0.138460
2	-0.016140	10	-0.138772	18	
3	0.142062	11	-0.021229	19	
4	-0.247191	12	0.125829	20	
5	0.075286	13	-0.195817	21	
6	0.099315	14	-0.076889	22	
7	-0.026705	15	0.018428	23	
8	-0.254156	16	-0.131722	24	

Above serial correlations significant if their absolute values are greater than 0.534522

Durbin-Watson Value 2.1008

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	1.889987	2.406246	0.7057143	0.7788658	4.033626
2	2.203147	2.364264	0.7847112	0.5547165	4.173811
3	1.827174				
4	2.794783	3.079815	0.7680835	1.308611	4.851018
5	2.398122	2.567297	0.8335438	0.6451416	4.489453
6	2.637758	2.437234	0.7038484	0.8141564	4.060311
7		2.416636	0.9868743	0.1408995	4.692372
8		1.669636	0.7355781	-2.661019E-02	3.365882
9	1.756125	1.284551	0.7752463	-0.5031697	3.072272
10	2.098266	2.59965	0.7906732	0.7763544	4.422945
11					
12	3.043962	2.828852	0.7036932	1.206132	4.451571
13	2.605734	2.250815	0.7116718	0.609697	3.891933
14		1.743334	0.7649637	-0.0206756	3.507344
15	3.2598				
16	3.112052				
17	1.586548	1.519638	0.7944489	-0.3123645	3.35164
18	5.100878	3.89169	0.7679604	2.12077	5.66261
19	4.208356	4.563325	0.7750478	2.776061	6.350588
20	4.388611	4.205434	0.7893248	2.385248	6.02562
21		1.135499	0.8989676	-0.9375237	3.208522
22	2.399586	3.113054	0.7021307	1.493938	4.732171

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Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	1.889987	2.406246	-0.516259	27.32	0.4107085
2	2.203147	2.364264	-0.1611166	7.31	0.4526802
3	1.827174				
4	2.794783	3.079815	-0.2850314	10.20	0.4388847
5	2.398122	2.567297	-0.1691753	7.05	0.4457146
6	2.637758	2.437234	0.200524	7.60	0.4530842
7		2.416636			
8		1.669636			
9	1.756125	1.284551	0.4715741	26.85	0.39807
10	2.098266	2.59965	-0.5013835	23.90	0.3804865
11					
12	3.043962	2.828852	0.2151108	7.07	0.4519663
13	2.605734	2.250815	0.3549194	13.62	0.436323
14		1.743334			
15	3.2598				
16	3.112052				
17	1.586548	1.519638	6.691018E-02	4.22	0.4590637
18	5.100878	3.89169	1.209188	23.71	7.117941E-02
19	4.208356	4.563325	-0.3549684	8.43	0.4251965
20	4.388611	4.205434	0.1831765	4.17	0.4499778
21		1.135499			
22	2.399586	3.113054	-0.7134683	29.73	0.366902

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
Maximum Design Landing Weight	36.800726	0.972827	0.027173	8.332035E-11
Oleo Extend Main	29176.288013	0.999966	0.000034	2.370685
SQRT Oleo Ext M	11679.257494	0.999914	0.000086	283.4624
SQRT WUC 45	51.384409	0.980539	0.019461	1.175839E-02
SQ Oleo Ext M	4394.565199	0.999772	0.000228	1.260749E-05

Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	4.131411	82.63	82.63	1.00
2	0.773926	15.48	98.11	5.34
3	0.058539	1.17	99.28	70.57
4	0.036102	0.72	100.00	114.44
5	0.000022	0.00	100.00	187119.76

Some Condition Numbers greater than 1000. Multicollinearity is a SEVERE problem.

Multiple Regression Report

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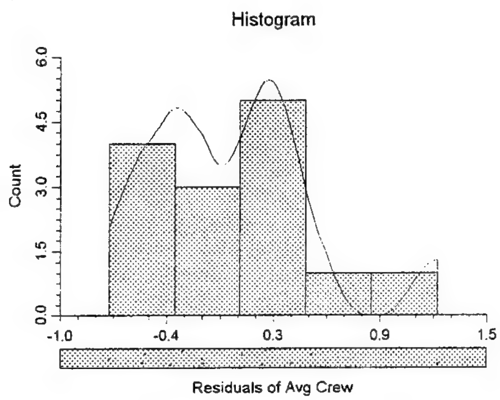
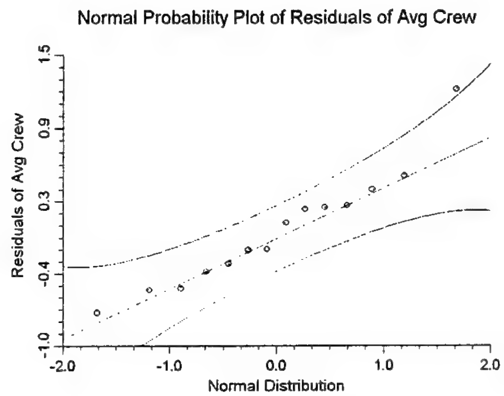
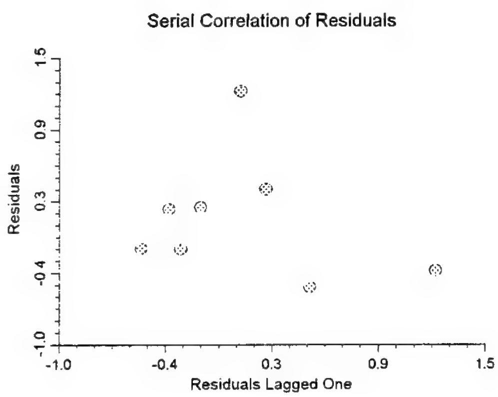
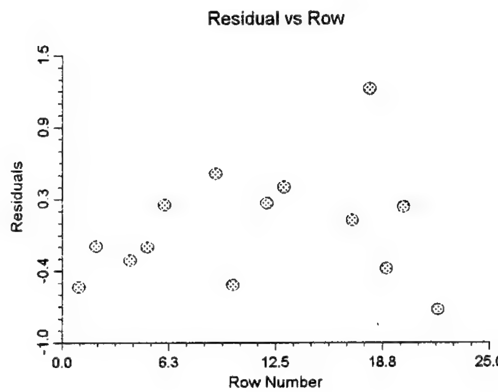
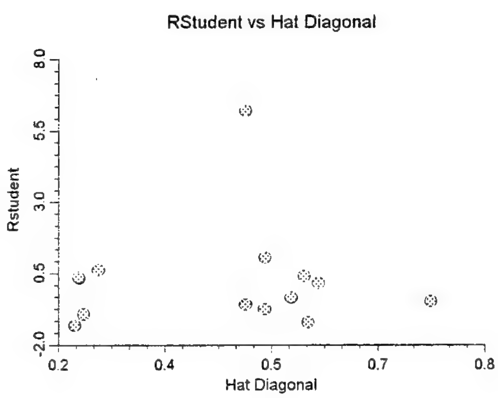
Plots Section

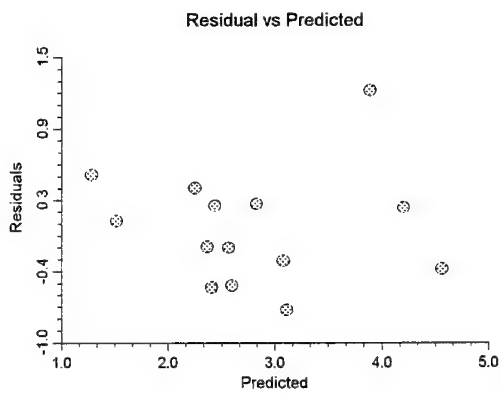












APPENDIX G

Appendix G
Landing Gear Parametric Equations

$$MTBMS = 26.32477 - .009372951\sqrt{W2} + 13.28845\sqrt{O4} - 59.99788(\log(O4))$$

$$MTBMSL = 12.22265 - .3476786(O4) - .01633815(LW)$$

$$MH / MA = 664.3605 - 6.929825(O2) + 243.2979\sqrt{O2} - .03721993\sqrt{FV} - 521.1387(\ln(O2))$$
$$+ 1.021577(\ln(FV))$$

$$SMH / FLYHR = 2.190422 - .0001160511(S2) - .0002416306(GG) + .04635748\sqrt{GG}$$
$$- .4802878(\ln(GG)) + .000000002295069(GG)^2$$

$$SMH / FLYHRL = .606491 + .0004577228(GG) - .00006246534(FV) - .02947245\sqrt{GG}$$

$$AVGCREW = 130.4958 - .00001617608(W4) + 3.888708(O2) - 42.96297\sqrt{O2} + .1757128\sqrt{H2}$$
$$- .008796215(O2)^2$$

$$AVGCREWL = 8.017035 - .7017691\sqrt{O2}$$

$$AVGCREWG = 161.5709 + .00003176874(W4) - 13.41338(\ln(W4))$$

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APPENDIX H

Appendix H
Engine Reliability and Maintainability Data

YEAR	EQ_DESIG	OP_TIME	SORTIES	TOTAL_FAIL	SCHED_HR	UNSCHED_HR	MTTR	YEAR	EQ_DESIG	OP_TIME	SORTIES
----	--------	-------	-------	----------	-----------	-----------	----	----	--------	-------	-------
1994	A010A	75,596.70	40826	13,977	14,276.50	62,751.60	0	1995	A010A	43,154.90	22636
	B001B	28,940.70	6646	19,680	13,641.70	80,275.00	0.01		B001B	16,056.70	3701
	B002A	1,189.00	302	569	313.3	2,160.00	0		B002A	1,512.00	333
	B052H	26,911.60	4561	18,481	27,540.50	74,392.00	0		B052H	14,250.80	2334
	C005B	42,708.80	10678	42,784	34,003.40	103,746.50	0		C005B	20,308.70	5330
	C009A	24,519.80	17676	5,626	5,598.50	22,463.50	0		C009A	14,527.30	10258
	C130H	100,867.50	50085	0	0	0	0				
	C141B	143,402.00	48644	101,982	104,764.40	314,162.80	0		C141B	93,927.50	30154
	E003B	17,635.40	2358	3,791	3,528.80	18,413.30	0		E003B	10,099.00	1492
	F004E	4,126.90	3427	783	178.7	4,729.00	0		F004E	2,571.80	2121
	F015C	101,157.30	66027	29,124	24,538.00	144,056.80	0		F015C	63,434.90	40503
	F016C	261,796.10	178033	9,163	5,366.60	55,413.40	0		F016C	163,075.60	109152
	F111F	17,748.70	7808	8,042	7,794.10	45,254.00	0		F111F	9,592.70	4177
	F117A	12,424.40	6880	1,171	486.3	8,259.50	0		F117A	7,553.40	4507
	KC010A	50,196.30	11442	10,061	7,244.50	41,521.60	0		KC010A	27,967.00	5889
	KC135A	1,742.50	410	739	681.1	4,836.20	0				
	T001A	35,875.20	14804	1,461	1,090.70	6,854.00	0		T001A	24,032.60	10451
	T037B	143,950.50	112178	19,877	17,410.10	71,155.50	0		T037B	80,246.10	62792
	T038A	165,125.40	137367	24,705	14,806.50	112,760.90	0		T038A	82,072.30	69176
	U002R	487.4	235	95	345.5	208	0		U002R	1,790.80	970

Appendix H
Engine Reliability and Maintainability Data

TOTAL_FAIL	SCHED_HRS	UNSCHED_HRS	MTTR	YEAR	EQ_DESIG	OP_TIME	SORTIES	TOTAL_FAIL	SCHED_HRS	UNSCHED_HR
----------	-----------	-----------	----	----	--------	-------	-------	----------	-----------	-----------
3,454	5,359.30	21,608.30	0	1996	A010A	29,782.30	15611	1,912	4,169.20	33,449.80
5,547	2,127.20	23,108.40	0		B001B	10,333.30	2226	2,659	3,697.80	65,799.00
448	1,814.50	1,408.70	0		B002A	1,266.00	277	298	679	5,039.70
5,729	8,861.20	18,653.60	0		B052H	8,978.60	1303	2,957	8,948.00	22,007.40
11,670	10,402.40	37,818.90	0		C005B	13,022.30	2848	7,224	6,524.70	59,093.60
820	1,100.50	2,408.00	0		C009A	8,322.60	5281	387	629.2	1,310.20
37,425	48,374.20	128,502.20	0		C141B	43,419.10	13836	15,540	26,457.80	56,062.00
1,415	1,303.20	5,444.70	0		E003B	6,176.00	873	795	1,039.20	3,177.30
392	91.3	2,230.20	0		F004E	1,697.90	1403	169	52.3	1,297.90
9,104	5,397.20	63,870.50	0		F015C	37,568.90	24409	4,553	5,141.70	149,633.30
3,982	2,463.20	33,218.80	0		F016C	112,200.20	74979	2,483	3,888.60	93,192.50
1,625	2,450.30	9,842.90	0		F111F	0	0	0	0	4,936.00
341	405.4	2,388.70	0		F117A	5,087.70	2927	176	307	2,872.30
1,376	907.5	7,339.80	0		KC010A	17,743.70	3667	693	464.2	6,251.00
468	148.9	2,758.10	0		T001A	22,237.30	10238	471	1,362.70	3,106.10
5,162	6,486.10	15,828.10	0		T037B	58,703.90	46014	2,402	18,615.70	19,744.80
6,579	3,605.30	27,876.70	0		T038A	45,342.20	38507	2,455	36,372.50	42,251.10
352	1,566.00	381.4	0		U002R	1,457.90	512	118	734	374.6

Appendix H
Engine Reliability and Maintainability Data

MTTR			Sum Op Time	Total Sorties	Sum Total Fail	Sum Sched Hr	Sum Unsche Hr	Sum MTTR			MTBM op/fail	MTBM sortie/fail
----												
3.13			148,533.90	79073	19,343	23,805.00	117,809.70	3.13			7.678948	4.087939
2.95			55,330.70	12573	27,886	19,466.70	169,182.40	2.96			1.984175	0.450871
4.96			3,967.00	912	1,315	2,806.80	8,608.40	4.96			3.01673	0.693536
1.67			50,141.00	8198	27,167	45,349.70	115,053.00	1.67			1.845658	0.301763
2.44			76,039.80	18856	61,678	50,930.50	200,659.00	2.44			1.232851	0.305717
2.09			47,369.70	33215	6,833	7,328.20	26,181.70	2.09			6.932489	4.860969
			0.00	0	0	0.00	0.00	0			0	0
			100,867.50	50085	0	0.00	0.00	0			0	0
			280,748.60	92634	154,947	179,596.40	498,727.00	0			1.811901	0.597843
1.41			33,910.40	4723	6,001	5,871.20	27,035.30	1.41			5.650792	0.787035
			0.00	0	0	0.00	0.00	0			0	0
1.53			8,396.60	6951	1,344	322.30	8,257.10	1.53			6.24747	5.171875
			202,161.10	130939	42,781	35,076.90	357,560.60	0			4.725488	3.060681
3.88			537,071.90	362164	15,628	11,718.40	181,824.70	3.88			34.366	23.17405
0			27,341.40	11985	9,667	10,244.40	60,032.90	0			2.828323	1.239785
2.91			25,065.50	14314	1,688	1,198.70	13,520.50	2.91			14.84923	8.479858
2.98			95,907.00	20998	12,130	8,616.20	55,112.40	2.98			7.906595	1.73108
			1,742.50	410	739	681.10	4,836.20	0			2.357916	0.554804
1.62			82,145.10	35493	2,400	2,602.30	12,718.20	1.62			34.22713	14.78875
			282,900.50	220984	27,441	42,511.90	106,728.40	0			10.30941	8.053059
			292,539.90	245050	33,739	54,784.30	182,888.70	0			8.670675	7.263108
			0.00	0	0	0.00	0.00	0			0	0
3.18			3,736.10	1717	565	2,645.50	964.00	3.18			6.612566	3.038938

Appendix H
Engine Reliability and Maintainability Data

MH/MA unsch/fail	SMH/FLY HRsch/op	AvgCrews izeam/ah
6.09056	0.160266	1.945866
6.06693	0.351825	2.049638
6.546312	0.707537	1.319821
4.235028	0.904443	2.535945
3.253332	0.669787	1.333333
3.831655	0.154702	1.833328
0	0	0
0	0	0
3.218694	0.639705	0
4.505132	0.173139	3.195129
0	0	0
6.143676	0.038385	4.015474
8.35793	0.17351	0
11.63455	0.021819	2.998595
6.210086	0.374685	0
8.009775	0.047823	2.7525
4.543479	0.089839	1.524657
6.544249	0.390875	0
5.29925	0.031679	3.271142
3.889377	0.150272	0
5.420691	0.187271	0
0	0	0
1.706195	0.708091	0.536539

APPENDIX I

Appendix I
Engine Independent Variables List

ENGINE INDEPENDENT VARIABLES LISTED

SYMBOL	VARIABLE	UNIT
W1	Weight Empty	lbs.
W5	Maximum Gross Weight	lbs.
W6	Weight of Engines	lbs.
NE	Number of Engines	
NG	Number of Generators	
KV	Maximum KVA	KVA
LS	Average Length of Sortie	hrs.
MS	Maximum Speed	kts.
NF	Number of Fan/Compressor Stages	
NT	Number of Turbine Stages (HP/LP)	
MP	Maximum Power at Sea Level	lbs t. or shp
PR	Overall Pressure Ratio at Maximum Power	
ED	Engine Maximum Envelope Diameter	in.
EL	Engine Maximum Envelope Length	in.
ML	Maximum Power Loading	lb/lb st or lb/shp
H2	WUC45 Hyd and Pneum Group Weight	lbs.
H1	Hydraulic System Capacity	gal.
H3	Number of Hydraulic Subsystems	
AC	WUC41 A/C & Anti-Ice Group Weight	lbs.
BC	BTU Cooling	BTU/hr/1000
FS	WUC46 Fuel System Weight	lbs.
FV	Fuselage Volume	cu ft.

APPENDIX J

Appendix J
Engine Independent and Dependent Variables

Vehicle	Weight Empty	Maximum Gross Weight	Weight of Engines	Number of Engines	Number of Generators	Maximum KVA	Average Length of Sortie	Maximum Speed	Number of Fan/Compressor Stages	Number of Turbine Stages	Maximum Power at Sea Level	Pressure Ratio at Max Pwr
A-10A	22060.6	50320	2880	2	2	40	1.7	381	15	6	9065	21
B-1B	182271	477000	17678.6	4	3	115		873	11	3	30780	26.8
B-2A	152723	376000	12632	4	1			684	12	3	19000	35.1
B-52H	170252	488000	31200	8		160	6.7	564	15	4	17000	13
C-5B	363458.3	920000	31592.5	4	6	484	3.9	494			43000	
C-9A	61872	108000	6318	2	3	40	1.2	495	13	4	14500	15.9
C-17A	269612	585000	28400	4	5	90		473	17	7	40900	27.6
C-130H	73962	175000	7392	4	5	200	2.8	335	14	4	4591	9.6
C141B	140821	343000	18746	4	6	252	3.3	493	16	4	21000	15.6
E-3A	166544	325000	18980	4	1	600	8.2	460	16	4	21000	15.6
E-4B	500000	805000	33960	4	2	1200	12	523	18	6	52500	30.1
F-4E	31514	61795	7704	2	2	63	1.2	1242	17	3	17820	13.4
F-15C	28473	68000	6294	2	2	60	1.3	1455	13	4	23770	25
F-16C	18656	42300	3728	1	2	60	1.3	1280	13	4	29100	33
F-111F	46969.8	96000	8044	2	3	57.4	2.4	1455	16	4	25100	22
F-117A	28440.1	52500	3460	2	1	40		561	10	2	10540	24
KC-10A	238741	593000	26526	3	4	360	4.4	530	18	6	52500	30.4
KC-135A	96412	297000	16380	4	4	120	3	504	16	3	13750	12.5
T-1A	9993.25	16230	1329.3	2	0		4.5	468	3	3	2900	12.6
T-37B	4073	6800	751.45	2	2			370	1	1	1025	3.9
T-38A	7621.4	12093	1157.5	2	2	8.5	1.2	715	8	2	3850	6.7
T-43	63874	109000	6754	2	2	50	6	488	13	4	14500	15.9
U-2R	15101	29000	5960	1	1		12	452	15	3	26500	12

Appendix J
Engine Independent and Dependent Variables

Engine Maximum Diameter	Engine Maximum Length	Max Power Loading	WUC45	Hydraulic System Capacity	Hyd Subs	WUC41	BTU Cooling	WUC46	Fuselage Volume	MTBM op/fail	MTBM sortie/fail	MH/MA unsch/fail
49	100	2.76	373.2		20	212.1	15.8	1157.4	793	7.678948	4.087939	6.09056
55	181		2701.9	167		6767.9		3536.8	9334	1.984175	0.450871	6.06693
46.5	100.5	5.43	4649			4150		5730		3.01673	0.693536	6.546312
53	136	3.59	2024	80.3	76	1143	180	5858	12447	1.845658	0.301763	4.235028
100	203.1	4.88	4483.7	282	72	3889.8	318	2645.1	86610.1	1.232851	0.305717	3.253332
42.5	124		752		12	1538	200	2288	7647	6.932489	4.860969	3.831655
84.5	146.8	3.59	5187	240		3617		5170	38290			
44.6	146.3	8.6	666	18.9	20	2121	78	3077	9060			
54	142		1605		33	2735	118	1806	19700	1.811901	0.597843	3.218694
54	142		796	55	13	4957		3151	16002	5.650792	0.787035	4.505132
105.3	183											
39.1	208.7	1.73	543	23	33	406	40	1932	1473	6.24747	5.171875	6.143676
46.5	191.2	1.45	437	22.9	30	786	155	1143	1830	4.725488	3.060681	8.35793
46.5	191.2		310.3		20	316.9	40	390.3	774.93	34.366	23.17405	11.63455
49	242		646	35	35	757	95.5	898	2089	2.828323	1.239785	6.210086
35	87		1206.9			565.9		856.6	2280	14.84923	8.479858	8.009775
105.3	183	3.75	4166		30	2293	145	4420	41300	7.906595	1.73108	4.543479
39	168		865	43	12	1454	130	4078	11550	2.357916	0.554804	6.544249
28	61	2.78	152.46			543.97		711.82		34.22713	14.78875	5.29925
22.3	35.4	3.65	52.58		8	66.48		227.72		10.30941	8.053059	3.889377
21	104.6	1.57	147.2	5.19	14	138.5		284.2	489	8.670675	7.263108	5.420691
42.5	124	3.72	568.1	23.8		1657.5		1862.9	10231			
43	259									6.612566	3.038938	1.706195

Appendix J
Engine Independent and Dependent Variables

SMH/FLY HRsch/op	AvgCrews izeam/ah
0.160266	1.945866
0.351825	2.049638
0.707537	1.319821
0.904443	2.535945
0.669787	1.333333
0.154702	1.833328
0.639705	
0.173139	3.195129
0.038385	4.015474
0.17351	
0.021819	2.998595
0.374685	
0.047823	2.7525
0.089839	1.524657
0.390875	
0.031679	3.271142
0.150272	
0.187271	
0.708091	0.536539

APPENDIX K

Appendix K
Engine MTBM Op Regression Data

Vehicle	Hyd Sys C	Wgt of En	WUC 46	SQRT Hyd	SQRT Wgt	SQRT WU	LN Hyd Sy	LN Wgt of	LN WUC 4
A-10A		2880	1157.4		53.66563	34.02058		7.965546	7.053931
B-1B	167	17678.6	3536.8	12.92285	132.9609	59.471	5.117994	9.78011	8.170978
B-2A		12632	5730		112.3922	75.69676		9.443989	8.653471
B-52H	80.3	31200	5858	8.961027	176.6352	76.53757	4.38577	10.34817	8.675564
C-5B	282	31592.5	2645.1	16.79286	177.7428	51.43054	5.641907	10.36068	7.880464
C-9A		6318	2288		79.48585	47.83304		8.751158	7.735433
C-17A	240	28400	5170	15.49193	168.523	71.90271	5.480639	10.25414	8.550628
C-130H	18.9	7392	3077	4.347413	85.97674	55.47071	2.939162	8.908154	8.03171
C141B		18746	1806		136.916	42.49706		9.838736	7.49887
E-3A	55	18980	3151	7.416198	137.7679	56.13377	4.007333	9.851141	8.055475
E-4B		33960			184.2824			10.43294	
F-4E	23	7704	1932	4.795832	87.77243	43.95452	3.135494	8.949495	7.566311
F-15C	22.9	6294	1143	4.785394	79.33473	33.80828	3.131137	8.747352	7.041412
F-16C		3728	390.3		61.05735	19.75601		8.223627	5.966916
F-111F	35	8044	898	5.91608	89.68835	29.96665	3.555348	8.992682	6.80017
F-117A		3460	856.6		58.82176	29.26773		8.149024	6.752971
KC-10A		26526	4420		162.868	66.48308		10.18588	8.393895
KC-135A	43	16380	4078	6.557439	127.9844	63.85922	3.7612	9.703816	8.313362
T-1A		1329.3	711.82		36.45957	26.67996		7.192408	6.567825
T-37B		751.45	227.72		27.41259	15.09039		6.622005	5.428117
T-38A	5.19	1157.5	284.2	2.278157	34.02205	16.85823	1.646734	7.054018	5.649678
T-43A	23.8	6754	1862.9	4.878524	82.18272	43.16133	3.169686	8.81789	7.52989
U-2R		5960			77.20104			8.692826	

Appendix K
Engine MTBM Op Regression Data

SQ Hyd Sy	SQ Wgt of	SQ WUC 4	LOG Hyd $	LOG Wgt (	LOG WUC	EXP Hyd $	EXP Wgt d	EXP WUC	MTBM Op
	8294400	1339575		3.459392	3.063483		1.050499	1.122018	7.678948
27889	3.1E+008	12508954	2.222716	4.247448	3.548611	2.97E-073	1.353116	1.421641	1.984175
	1.6E+008	32832900		4.101472	3.758155		1.241205	1.76822	3.01673
6448.09	9.7E+008	34316164	1.904716	4.494155	3.767749	1.34E-035	1.705241	1.790878	1.845658
79524	1E+009	6996554	2.450249	4.499584	3.422442	3.38E-123	1.716729	1.300974	1.232851
	39917124	5234944		3.80058	3.359456		1.114132	1.255572	6.932489
57600	8.1E+008	26728900	2.380211	4.453318	3.713491	5.88E-105	1.625491	1.672416	
357.21	54641664	9467929	1.276462	3.868762	3.488127	6.19E-009	1.13479	1.358084	
	3.5E+008	3261636		4.272909	3.256718		1.378049	1.196794	1.811901
3025	3.6E+008	9928801	1.740363	4.278296	3.498448	1.3E-024	1.383576	1.368117	5.650792
	1.2E+009			4.530968			1.78768		
529	59351616	3732624	1.361728	3.886716	3.286007	1.03E-010	1.140862	1.211888	6.24747
524.41	39614436	1306449	1.359835	3.798927	3.058046	1.13E-010	1.113675	1.120412	4.725488
	13897984	152334.1		3.571476	2.591399		1.065848	1.039587	34.366
1225	64705936	806404	1.544068	3.905472	2.953276	6.31E-016	1.147517	1.093437	2.828323
	11971600	733763.6		3.539076	2.932778		1.060973	1.088943	14.84923
	7E+008	19536400		4.423672	3.645422		1.574209	1.552188	7.906595
1849	2.7E+008	16630084	1.633468	4.214314	3.610447	2.12E-019	1.323389	1.500271	2.357916
	1767038	506687.7		3.123623	2.85237		1.022999	1.073373	34.22713
	564677.1	51856.4		2.8759	2.357401		1.012937	1.02291	10.30941
26.9361	1339806	80769.64	0.715167	3.063521	2.453624	0.005572	1.019997	1.028673	8.670675
566.44	45616516	3470396	1.376577	3.829561	3.27019	4.61E-011	1.122472	1.203587	
	35521600			3.775246			1.10733		6.612566

Appendix K
Engine MTBM Op Regression Data

MTBM Op
7.678948
1.984175
3.01673
1.845658
1.232851
6.932489
1.811901
5.650792
6.24747
4.725488
2.828323
14.84923
7.906595
2.357916
10.30941
8.670675
6.612566

Appendix K
Engine MTBM S Regression Data

Vehicle	WUC 46	Wgt of En	Num of En	SQRT WU	SQRT Wgt	SQRT Nun	LN WUC 4	LN Wgt of	LN Num o
A-10A	1157.4	2880	2	34.02058	53.66563	1.414214	7.053931	7.965546	0.693147
B-1B	3536.8	17678.6	4	59.471	132.9609	2	8.170978	9.78011	1.386294
B-2A	5730	12632	4	75.69676	112.3922	2	8.653471	9.443989	1.386294
B-52H	5858	31200	8	76.53757	176.6352	2.828427	8.675564	10.34817	2.079442
C-5B	2645.1	31592.5	4	51.43054	177.7428	2	7.880464	10.36068	1.386294
C-9A	2288	6318	2	47.83304	79.48585	1.414214	7.735433	8.751158	0.693147
C-17A	5170	28400	4	71.90271	168.523	2	8.550628	10.25414	1.386294
C-130H	3077	7392	4	55.47071	85.97674	2	8.03171	8.908154	1.386294
C141B	1806	18746	4	42.49706	136.916	2	7.49887	9.838736	1.386294
E-3A	3151	18980	4	56.13377	137.7679	2	8.055475	9.851141	1.386294
E-4B		33960	4		184.2824	2		10.43294	1.386294
F-4E	1932	7704	2	43.95452	87.77243	1.414214	7.566311	8.949495	0.693147
F-15C	1143	6294	2	33.80828	79.33473	1.414214	7.041412	8.747352	0.693147
F-16C	390.3	3728	1	19.75601	61.05735	1	5.966916	8.223627	0
F-111F	898	8044	2	29.96665	89.68835	1.414214	6.80017	8.992682	0.693147
F-117A	856.6	3460	2	29.26773	58.82176	1.414214	6.752971	8.149024	0.693147
KC-10A	4420	26526	3	66.48308	162.868	1.732051	8.393895	10.18588	1.098612
KC-135A	4078	16380	4	63.85922	127.9844	2	8.313362	9.703816	1.386294
T-1A	711.82	1329.3	2	26.67996	36.45957	1.414214	6.567825	7.192408	0.693147
T-37B	227.72	751.45	2	15.09039	27.41259	1.414214	5.428117	6.622005	0.693147
T-38A	284.2	1157.5	2	16.85823	34.02205	1.414214	5.649678	7.054018	0.693147
T-43A	1862.9	6754	2	43.16133	82.18272	1.414214	7.52989	8.81789	0.693147
U-2R		5960	1		77.20104	1		8.692826	0

Appendix K
Engine MTBM S Regression Data

SQ WUC 4	SQ Wgt of	SQ Num o	LOG WUC	LOG Wgt (	LOG Num	EXP WUC	EXP Wgt d	EXP Num	MTBM S
1339575	8294400	4	3.063483	3.459392	0.30103	1.106641	1.044314	0.135335	4.087939
12508954	3.1E+008	16	3.548611	4.247448	0.60206	1.362938	1.304949	0.018316	0.450871
32832900	1.6E+008	16	3.758155	4.101472	0.60206	1.651452	1.209472	0.018316	0.693536
34316164	9.7E+008	64	3.767749	4.494155	0.90309	1.670062	1.599575	0.000335	0.301763
6996554	1E+009	16	3.422442	4.499584	0.60206	1.260584	1.609056	0.018316	0.305717
5234944	39917124	4	3.359456	3.80058	0.30103	1.221783	1.099793	0.135335	4.860969
26728900	8.1E+008	16	3.713491	4.453318	0.60206	1.572438	1.533545	0.018316	
9467929	54641664	16	3.488127	3.868762	0.60206	1.309163	1.117721	0.018316	
3261636	3.5E+008	16	3.256718	4.272909	0.60206	1.171299	1.326089	0.018316	0.597843
9928801	3.6E+008	16	3.498448	4.278296	0.60206	1.317672	1.330769	0.018316	0.787035
	1.2E+009	16		4.530968	0.60206		1.667444	0.018316	
3732624	59351616	4	3.286007	3.886716	0.30103	1.184291	1.122984	0.135335	5.171875
1306449	39614436	4	3.058046	3.798927	0.30103	1.105246	1.099396	0.135335	3.060681
152334.1	13897984	1	2.591399	3.571476	0	1.034761	1.057733	0.367879	23.17405
806404	64705936	4	2.953276	3.905472	0.30103	1.081792	1.128747	0.135335	1.239785
733763.6	11971600	4	2.932778	3.539076	0.30103	1.077878	1.053473	0.135335	8.479858
19536400	7E+008	9	3.645422	4.423672	0.477121	1.472506	1.490882	0.049787	1.73108
16630084	2.7E+008	16	3.610447	4.214314	0.60206	1.42907	1.279683	0.018316	0.554804
506687.7	1767038	4	2.85237	3.123623	0.30103	1.064302	1.020215	0.135335	14.78875
51856.4	564677.1	4	2.357401	2.8759	0.30103	1.020137	1.011378	0.135335	8.053059
80769.64	1339806	4	2.453624	3.063521	0.30103	1.025193	1.01758	0.135335	7.263108
3470396	45616516	4	3.27019	3.829561	0.30103	1.177148	1.107036	0.135335	
	35521600	1		3.775246	0		1.093881	0.367879	3.038938

Appendix K
Engine MH/MA Regression Data

Vehicle	Max Spee	Hyd Sys C	Avg Len S	SQRT Max	SQRT Hyd	SQRT Avg	LN Max S	LN Hyd Sy	LN Avg Le
A-10A	381		1.7	19.51922		1.30384	5.942799		0.530628
B-1B	873	167		29.54657	12.92285		6.771936	5.117994	
B-2A	684			26.15339			6.527958		
B-52H	564	80.3	6.7	23.74868	8.961027	2.588436	6.335054	4.38577	1.902108
C-5B	494	282	3.9	22.22611	16.79286	1.974842	6.202536	5.641907	1.360977
C-9A	495		1.2	22.2486		1.095445	6.204558		0.182322
C-17A	473	240		21.74856	15.49193		6.159095	5.480639	
C-130H	335	18.9	2.8	18.30301	4.347413	1.67332	5.814131	2.939162	1.029619
C141B	493		3.3	22.2036		1.81659	6.200509		1.193922
E-3A	460	55	8.2	21.44761	7.416198	2.863564	6.131226	4.007333	2.104134
E-4B	523		12	22.86919		3.464102	6.259581		2.484907
F-4E	1242	23	1.2	35.24202	4.795832	1.095445	7.124478	3.135494	0.182322
F-15C	1455	22.9	1.3	38.14446	4.785394	1.140175	7.282761	3.131137	0.262364
F-16C	1280		1.3	35.77709		1.140175	7.154615		0.262364
F-111F	1455	35	2.4	38.14446	5.91608	1.549193	7.282761	3.555348	0.875469
F-117A	561			23.68544			6.329721		
KC-10A	530		4.4	23.02173		2.097618	6.272877		1.481605
KC-135A	504	43	3	22.44994	6.557439	1.732051	6.222576	3.7612	1.098612
T-1A	468		4.5	21.63331		2.12132	6.148468		1.504077
T-37B	370			19.23538			5.913503		
T-38A	715	5.19	1.2	26.73948	2.278157	1.095445	6.572283	1.646734	0.182322
T-43A	488	23.8	6	22.09072	4.878524	2.44949	6.190315	3.169686	1.791759
U-2R	452		12	21.26029		3.464102	6.113682		2.484907

Appendix K
Engine MH/MA Regression Data

SQ Max S	SQ Hyd S	SQ Avg L	LOG Max	LOG Hyd	LOG Avg	EXP Max	EXP Hyd	EXP Avg L	MH/MA
145161		2.89	2.580925		0.230449	1.123053		0.182684	6.09056
762129	27889		2.941014	2.222716		1.304619	2.97E-073		6.06693
467856			2.835056			1.231635			6.546312
318096	6448.09	44.89	2.751279	1.904716	0.826075	1.18743	1.34E-035	0.001231	4.235028
244036	79524	15.21	2.693727	2.450249	0.591065	1.16238	3.38E-123	0.020242	3.253332
245025		1.44	2.694605		0.079181	1.162734		0.301194	3.831655
223729	57600		2.674861	2.380211		1.154969	5.88E-105		
112225	357.21	7.84	2.525045	1.276462	0.447158	1.107427	6.19E-009	0.06081	
243049		10.89	2.692847		0.518514	1.162026		0.036883	3.218694
211600	3025	67.24	2.662758	1.740363	0.913814	1.150404	1.3E-024	0.000275	4.505132
273529		144	2.718502		1.079181	1.172693		6.14E-006	
1542564	529	1.44	3.094122	1.361728	0.079181	1.459811	1.03E-010	0.301194	6.143676
2117025	524.41	1.69	3.162863	1.359835	0.113943	1.557661	1.13E-010	0.272532	8.35793
1638400		1.69	3.10721		0.113943	1.476806		0.272532	11.63455
2117025	1225	5.76	3.162863	1.544068	0.380211	1.557661	6.31E-016	0.090718	6.210086
314721			2.748963			1.186346			8.009775
280900		19.36	2.724276		0.643453	1.175196		0.012277	4.543479
254016	1849	9	2.702431	1.633468	0.477121	1.165926	2.12E-019	0.049787	6.544249
219024		20.25	2.670246		0.653213	1.153211		0.011109	5.29925
136900			2.568202			1.119296			3.889377
511225	26.9361	1.44	2.854306	0.715167	0.079181	1.24332	0.005572	0.301194	5.420691
238144	566.44	36	2.68842	1.376577	0.778151	1.160258	4.61E-011	0.002479	
204304		144	2.655138		1.079181	1.147605		6.14E-006	1.706195

Appendix K
Engine SMH/FLYHR Regression Data

Vehicle	Hyd Subs	Max Powe	Num of Er	SQRT Hyd	SQRT Max	SQRT Nur	LN Hyd Su	LN Max Pc	LN Num o
A-10A	20	2.76	2	4.472136	1.661325	1.414214	2.995732	1.015231	0.693147
B-1B			4			2			1.386294
B-2A		5.43	4		2.330236	2		1.691939	1.386294
B-52H	76	3.59	8	8.717798	1.89473	2.828427	4.330733	1.278152	2.079442
C-5B	72	4.88	4	8.485281	2.209072	2	4.276666	1.585145	1.386294
C-9A	12		2	3.464102		1.414214	2.484907		0.693147
C-17A		3.59	4		1.89473	2		1.278152	1.386294
C-130H	20	8.6	4	4.472136	2.932576	2	2.995732	2.151762	1.386294
C141B	33		4	5.744563		2	3.496508		1.386294
E-3A	13		4	3.605551		2	2.564949		1.386294
E-4B			4			2			1.386294
F-4E	33	1.73	2	5.744563	1.315295	1.414214	3.496508	0.548121	0.693147
F-15C	30	1.45	2	5.477226	1.204159	1.414214	3.401197	0.371564	0.693147
F-16C	20		1	4.472136		1	2.995732		0
F-111F	35		2	5.91608		1.414214	3.555348		0.693147
F-117A			2			1.414214			0.693147
KC-10A	30	3.75	3	5.477226	1.936492	1.732051	3.401197	1.321756	1.098612
KC-135A	12		4	3.464102		2	2.484907		1.386294
T-1A		2.78	2		1.667333	1.414214		1.022451	0.693147
T-37B	8	3.65	2	2.828427	1.910497	1.414214	2.079442	1.294727	0.693147
T-38A	14	1.57	2	3.741657	1.252996	1.414214	2.639057	0.451076	0.693147
T-43A		3.72	2		1.92873	1.414214		1.313724	0.693147
U-2R			1			1			0

Appendix K
Engine SMH/FLYHR Regression Data

SQ Hyd S	SQ Max P	SQ Num o	LOG Hyd	LOG Max	LOG Num	EXP Hyd	EXP Max	EXP Num	SMH/Op
400	7.6176	4	1.30103	0.440909	0.30103	2.06E-009	0.063292	0.135335	0.160266
		16			0.60206			0.018316	0.351825
	29.4849	16		0.7348	0.60206		0.004383	0.018316	0.707537
5776	12.8881	64	1.880814	0.555094	0.90309	9.85E-034	0.027598	0.000335	0.904443
5184	23.8144	16	1.857332	0.68842	0.60206	5.38E-032	0.007597	0.018316	0.669787
144		4	1.079181		0.30103	6.14E-006		0.135335	0.154702
	12.8881	16		0.555094	0.60206		0.027598	0.018316	
400	73.96	16	1.30103	0.934498	0.60206	2.06E-009	0.000184	0.018316	
1089		16	1.518514		0.60206	4.66E-015		0.018316	0.639705
169		16	1.113943		0.60206	2.26E-006		0.018316	0.173139
		16			0.60206			0.018316	
1089	2.9929	4	1.518514	0.238046	0.30103	4.66E-015	0.177284	0.135335	0.038385
900	2.1025	4	1.477121	0.161368	0.30103	9.36E-014	0.23457	0.135335	0.17351
400		1	1.30103		0	2.06E-009		0.367879	0.021819
1225		4	1.544068		0.30103	6.31E-016		0.135335	0.374685
		4			0.30103			0.135335	0.047823
900	14.0625	9	1.477121	0.574031	0.477121	9.36E-014	0.023518	0.049787	0.089839
144		16	1.079181		0.60206	6.14E-006		0.018316	0.390875
	7.7284	4		0.444045	0.30103		0.062039	0.135335	0.031679
64	13.3225	4	0.90309	0.562293	0.30103	0.000335	0.025991	0.135335	0.150272
196	2.4649	4	1.146128	0.1959	0.30103	8.32E-007	0.208045	0.135335	0.187271
	13.8384	4		0.570543	0.30103		0.024234	0.135335	
		1			0			0.367879	0.708091

Appendix K
Engine AVG CREW Regression Data

Vehicle	Hyd Sys C	WUC 45	Max Powe	SQRT Hyd	SQRT WU	SQRT Max	LN Hyd Sy	LN WUC 4	LN Max Po
A-10A		373.2	2.76		19.31839	1.661325		5.922114	1.015231
B-1B	167	2701.9		12.92285	51.9798		5.117994	7.901711	
B-2A		4649	5.43		68.18358	2.330236		8.444407	1.691939
B-52H	80.3	2024	3.59	8.961027	44.98889	1.89473	4.38577	7.612831	1.278152
C-5B	282	4483.7	4.88	16.79286	66.96044	2.209072	5.641907	8.408204	1.585145
C-9A		752			27.42262			6.622736	
C-17A	240	5187	3.59	15.49193	72.02083	1.89473	5.480639	8.553911	1.278152
C-130H	18.9	666	8.6	4.347413	25.80698	2.932576	2.939162	6.50129	2.151762
C141B		1605			40.06245			7.380879	
E-3A	55	796		7.416198	28.21347		4.007333	6.679599	
E-4B									
F-4E	23	543	1.73	4.795832	23.30236	1.315295	3.135494	6.297109	0.548121
F-15C	22.9	437	1.45	4.785394	20.90454	1.204159	3.131137	6.079933	0.371564
F-16C		310.3			17.61533			5.73754	
F-111F	35	646		5.91608	25.41653		3.555348	6.4708	
F-117A		1206.9			34.74047			7.09581	
KC-10A		4166	3.75		64.54456	1.936492		8.334712	1.321756
KC-135A	43	865		6.557439	29.41088		3.7612	6.76273	
T-1A		152.46	2.78		12.34747	1.667333		5.026902	1.022451
T-37B		52.58	3.65		7.251207	1.910497		3.962336	1.294727
T-38A	5.19	147.2	1.57	2.278157	12.1326	1.252996	1.646734	4.991792	0.451076
T-43A	23.8	568.1	3.72	4.878524	23.83485	1.92873	3.169686	6.342297	1.313724
U-2R									

Appendix K
Engine AVG CREW Regression Data

SQ Hyd S	SQ WUC 4	SQ Max P	LOG Hyd S	LOG WUC	LOG Max	EXP Hyd S	EXP WUC	EXP Max F	Avg Crew
	139278.2	7.6176		2.571942	0.440909		1.039761	0.063292	1.945866
27889	7300264		2.222716	3.431669		2.97E-073	1.326159		2.049638
	21613201	29.4849		3.66736	0.7348		1.625336	0.004383	1.319821
6448.09	4096576	12.8881	1.904716	3.306211	0.555094	1.34E-035	1.235483	0.027598	2.535945
79524	20103566	23.8144	2.450249	3.651637	0.68842	3.38E-123	1.597508	0.007597	1.333333
	565504			2.876218			1.081736		1.833328
57600	26904969	12.8881	2.380211	3.714916	0.555094	5.88E-105	1.719311	0.027598	
357.21	443556	73.96	1.276462	2.823474	0.934498	6.19E-009	1.07206	0.000184	
	2576025			3.205475			1.182565		
3025	633616		1.740363	2.900913		1.3E-024	1.08672		3.195129
529	294849	2.9929	1.361728	2.7348	0.238046	1.03E-010	1.058371	0.177284	4.015474
524.41	190969	2.1025	1.359835	2.640481	0.161368	1.13E-010	1.046715	0.23457	
	96286.09			2.491782			1.032951		2.998595
1225	417316		1.544068	2.810233		6.31E-016	1.069822		
	1456608			3.081671			1.134388		2.7525
	17355556	14.0625		3.619719	0.574031		1.545353	0.023518	1.524657
1849	748225		1.633468	2.937016		2.12E-019	1.094582		
	23244.05	7.7284		2.183156	0.444045		1.016056	0.062039	3.271142
	2764.656	13.3225		1.720821	0.562293		1.005509	0.025991	
26.9361	21667.84	2.4649	0.715167	2.167908	0.1959	0.005572	1.015498	0.208045	
566.44	322737.6	13.8384	1.376577	2.754425	0.570543	4.61E-011	1.06115	0.024234	
									0.536539

APPENDIX L

Correlation Report

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Pearson Correlations Section (Pair-Wise Deletion)

	Weight Empty	Max Gross Wgt	Wgt of Engines	Num of Engines		Num of Gen
KVA						
Weight Empty	1.000000	0.959325	0.914015	0.561805	0.417151	0.841284
Max Gross Wgt	0.959325	1.000000	0.951930	0.659340	0.544363	0.698952
Wgt of Engines	0.914015	0.951930	1.000000	0.754261	0.551898	0.669651
Num of Engines	0.561805	0.659340	0.754261	1.000000	0.549118	0.335616
Num of Gen	0.417151	0.544363	0.551898	0.549118	1.000000	0.036458
Max KVA	0.841284	0.698952	0.669651	0.335616	0.036458	1.000000
Avg Len Sortie	0.511881	0.401114	0.473432	0.253786	-0.283791	0.852751
Max Speed	-0.245964	-0.249933	-0.213728	-0.292646	-0.150468	-0.297407
Num Fan/Comp	0.500693	0.520320	0.608482	0.297571	0.445267	0.500083
Num Turb Stages	0.610889	0.591631	0.600741	0.230386	0.400391	0.398275
Max Power	0.791910	0.770581	0.756498	0.194992	0.353113	0.614545
Press Ratio	0.482280	0.484038	0.369811	0.023165	-0.005410	0.269036
Max Diameter	0.893797	0.883426	0.848401	0.364305	0.487250	0.698796
Max Length	0.246670	0.259493	0.317601	-0.045792	0.268118	0.219328
Max Pwr Load	0.338317	0.340149	0.223591	0.392435	0.494694	0.486172
WUC45	0.876199	0.863917	0.771210	0.470720	0.450256	0.416734
Hyd Sys Cap	0.944901	0.928275	0.800967	0.335264	0.669712	0.375978
Hyd Subs	0.650679	0.697540	0.737112	0.631452	0.573551	0.261157
WUC41	0.728159	0.696625	0.601155	0.466657	0.302618	0.591143
BTU Cooling	0.786611	0.776481	0.700098	0.414844	0.563411	0.644357
WUC46	0.693321	0.706708	0.771658	0.796679	0.349735	0.371093
Fuse Vol	0.910180	0.898863	0.765487	0.331311	0.670731	0.656503
MTBM Op	-0.453580	-0.458306	-0.508559	-0.477968	-0.487511	-0.267743
MTBM Sortie	-0.542498	-0.541337	-0.596140	-0.551264	-0.429681	-0.394669
MH/MA	-0.333630	-0.314882	-0.350705	-0.268029	-0.279423	-0.506975
SchHr/Op	0.482822	0.525968	0.587568	0.649561	0.411353	0.281404
Avg Crew Size	-0.349942	-0.364937	-0.245679	-0.014197	-0.356817	-0.190238

Cronbachs Alpha = 0.541347 Standardized Cronbachs Alpha = 0.891367

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Pearson Correlations Section (Pair-Wise Deletion)

	Avg Len Sortie	Max Speed	Num Fan/Comp	Num Turb Stages	Max Power	Ratio
Weight Empty	0.511881	-0.245964	0.500693	0.610889	0.791910	0.482280
Max Gross Wgt	0.401114	-0.249933	0.520320	0.591631	0.770581	0.484038
Wgt of Engines	0.473432	-0.213728	0.608482	0.600741	0.756498	0.369811
Num of Engines	0.253786	-0.292646	0.297571	0.230386	0.194992	0.023165
Num of Gen	-0.283791	-0.150468	0.445267	0.400391	0.353113	-0.005410
Max KVA	0.852751	-0.297407	0.500083	0.398275	0.614545	0.269036
Avg Len Sortie	1.000000	-0.426170	0.247352	0.204773	0.412991	0.042345
Max Speed	-0.426170	1.000000	0.136506	-0.085191	0.136884	0.340754
Num Fan/Comp	0.247352	0.136506	1.000000	0.693397	0.643047	0.392213
Num Turb Stages	0.204773	-0.085191	0.693397	1.000000	0.673049	0.516356
Max Power	0.412991	0.136884	0.643047	0.673049	1.000000	0.705325
Press Ratio	0.042345	0.340754	0.392213	0.516356	0.705325	1.000000
Max Diameter	0.383547	-0.125054	0.661286	0.820866	0.920335	0.620553
Max Length	0.229104	0.499386	0.697764	0.297912	0.617836	0.277376
Max Pwr Load	0.300577	-0.558576	0.102033	0.089089	0.016126	0.039874
WUC45	0.302787	-0.197449	0.363421	0.473542	0.738847	0.620957
Hyd Sys Cap	0.219262	-0.301791	0.208975	0.661928	0.878911	0.682582
Hyd Subs	0.356727	0.081492	0.386376	0.270475	0.468360	0.146072
WUC41	0.637845	-0.193326	0.264863	0.204842	0.499100	0.368358
BTU Cooling	0.451175	-0.269188	-0.115041	-0.111276	0.454621	-0.150925
WUC46	0.567255	-0.282340	0.495114	0.401984	0.434270	0.308750
Fuse Vol	0.316980	-0.364340	0.569448	0.655687	0.700325	0.288952
MTBM Op	-0.125247	0.077791	-0.478297	-0.097171	-0.235438	0.106628
MTBM Sortie	-0.280307	0.198457	-0.475287	-0.193948	-0.276636	0.075477
MH/MA	-0.595614	0.632886	-0.014783	0.033084	-0.048468	0.588446
SchHr/Op	0.528467	-0.220306	0.279473	0.000648	0.216482	-0.047218
Avg Crew Size	-0.411477	0.495396	-0.180298	-0.211427	-0.437688	-0.245253

Cronbachs Alpha = 0.541347 Standardized Cronbachs Alpha = 0.891367

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Pearson Correlations Section (Pair-Wise Deletion)

	Max Diameter	Max Length	Max Pwr Load	WUC45	Hyd Sys Cap	Hyd Subs
Weight Empty	0.893797	0.246670	0.338317	0.876199	0.944901	0.650679
Max Gross Wgt	0.883426	0.259493	0.340149	0.863917	0.928275	0.697540
Wgt of Engines	0.848401	0.317601	0.223591	0.771210	0.800967	0.737112
Num of Engines	0.364305	-0.045792	0.392435	0.470720	0.335264	0.631452
Num of Gen	0.487250	0.268118	0.494694	0.450256	0.669712	0.573551
Max KVA	0.698796	0.219328	0.486172	0.416734	0.375978	0.261157
Avg Len Sortie	0.383547	0.229104	0.300577	0.302787	0.219262	0.356727
Max Speed	-0.125054	0.499386	-0.558576	-0.197449	-0.301791	0.081492
Num Fan/Comp	0.661286	0.697764	0.102033	0.363421	0.208975	0.386376
Num Turb Stages	0.820866	0.297912	0.089089	0.473542	0.661928	0.270475
Max Power	0.920335	0.617836	0.016126	0.738847	0.878911	0.468360
Press Ratio	0.620553	0.277376	0.039874	0.620957	0.682582	0.146072
Max Diameter	1.000000	0.422798	0.223722	0.790250	0.925333	0.552096
Max Length	0.422798	1.000000	-0.020159	0.202385	0.172001	0.398766
Max Pwr Load	0.223722	-0.020159	1.000000	0.307500	0.178009	0.090358
WUC45	0.790250	0.202385	0.307500	1.000000	0.974208	0.654587
Hyd Sys Cap	0.925333	0.172001	0.178009	0.974208	1.000000	0.699229
Hyd Subs	0.552096	0.398766	0.090358	0.654587	0.699229	1.000000
WUC41	0.498073	0.219574	0.565684	0.639105	0.638062	0.226490
BTU Cooling	0.567350	0.098538	0.126896	0.701089	0.911926	0.581883
WUC46	0.519316	0.159101	0.427032	0.732819	0.462484	0.464436
Fuse Vol	0.861472	0.243613	0.309479	0.825946	0.860438	0.573353
MTBM Op	-0.302948	-0.289886	-0.234569	-0.396416	-0.654823	-0.345315
MTBM Sortie	-0.389673	-0.250682	-0.434027	-0.481502	-0.547773	-0.348201
MH/MA	-0.209359	-0.000424	-0.504206	-0.272312	-0.597845	-0.249313
SchHr/Op	0.253988	0.256784	0.650406	0.565521	0.544591	0.767674
Avg Crew Size	-0.428102	-0.287311	-0.852713	-0.756624	-0.937830	-0.237102

Cronbachs Alpha = 0.541347 Standardized Cronbachs Alpha = 0.891367

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Pearson Correlations Section (Pair-Wise Deletion)

	WUC41	BTU Cooling	WUC46	Fuse Vol	MTBM Op	MTBM Sortie
Weight Empty	0.728159	0.786611	0.693321	0.910180	-0.453580	-0.542498
Max Gross Wgt	0.696625	0.776481	0.706708	0.898863	-0.458306	-0.541337
Wgt of Engines	0.601155	0.700098	0.771658	0.765487	-0.508559	-0.596140
Num of Engines	0.466657	0.414844	0.796679	0.331311	-0.477968	-0.551264
Num of Gen	0.302618	0.563411	0.349735	0.670731	-0.487511	-0.429681
Max KVA	0.591143	0.644357	0.371093	0.656503	-0.267743	-0.394669
Avg Len Sortie	0.637845	0.451175	0.567255	0.316980	-0.125247	-0.280307
Max Speed	-0.193326	-0.269188	-0.282340	-0.364340	0.077791	0.198457
Num Fan/Comp	0.264863	-0.115041	0.495114	0.569448	-0.478297	-0.475287
Num Turb Stages	0.204842	-0.111276	0.401984	0.655687	-0.097171	-0.193948
Max Power	0.499100	0.454621	0.434270	0.700325	-0.235438	-0.276636
Press Ratio	0.368358	-0.150925	0.308750	0.288952	0.106628	0.075477
Max Diameter	0.498073	0.567350	0.519316	0.861472	-0.302948	-0.389673
Max Length	0.219574	0.098538	0.159101	0.243613	-0.289886	-0.250682
Max Pwr Load	0.565684	0.126896	0.427032	0.309479	-0.234569	-0.434027
WUC45	0.639105	0.701089	0.732819	0.825946	-0.396416	-0.481502
Hyd Sys Cap	0.638062	0.911926	0.462484	0.860438	-0.654823	-0.547773
Hyd Subs	0.226490	0.581883	0.464436	0.573353	-0.345315	-0.348201
WUC41	1.000000	0.739113	0.591491	0.474622	-0.416626	-0.513451
BTU Cooling	0.739113	1.000000	0.401478	0.774384	-0.452291	-0.455158
WUC46	0.591491	0.401478	1.000000	0.416608	-0.499556	-0.604028
Fuse Vol	0.474622	0.774384	0.416608	1.000000	-0.295150	-0.347599
MTBM Op	-0.416626	-0.452291	-0.499556	-0.295150	1.000000	0.946329
MTBM Sortie	-0.513451	-0.455158	-0.604028	-0.347599	0.946329	1.000000
MH/MA	-0.274320	-0.567467	-0.272394	-0.518369	0.480697	0.570085
SchHr/Op	0.400859	0.555210	0.642057	0.432488	-0.564104	-0.581259
Avg Crew Size	-0.398676	-0.629419	-0.464214	-0.598179	0.438015	0.447518

Cronbachs Alpha = 0.541347 Standardized Cronbachs Alpha = 0.891367

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Pearson Correlations Section (Pair-Wise Deletion)

	MH/MA	SchHr/Op	Avg Crew Size
Weight Empty	-0.333630	0.482822	-0.349942
Max Gross Wgt	-0.314882	0.525968	-0.364937
Wgt of Engines	-0.350705	0.587568	-0.245679
Num of Engines	-0.268029	0.649561	-0.014197
Num of Gen	-0.279423	0.411353	-0.356817
Max KVA	-0.506975	0.281404	-0.190238
Avg Len Sortie	-0.595614	0.528467	-0.411477
Max Speed	0.632886	-0.220306	0.495396
Num Fan/Comp	-0.014783	0.279473	-0.180298
Num Turb Stages	0.033084	0.000648	-0.211427
Max Power	-0.048468	0.216482	-0.437688
Press Ratio	0.588446	-0.047218	-0.245253
Max Diameter	-0.209359	0.253988	-0.428102
Max Length	-0.000424	0.256784	-0.287311
Max Pwr Load	-0.504206	0.650406	-0.852713
WUC45	-0.272312	0.565521	-0.756624
Hyd Sys Cap	-0.597845	0.544591	-0.937830
Hyd Subs	-0.249313	0.767674	-0.237102
WUC41	-0.274320	0.400859	-0.398676
BTU Cooling	-0.567467	0.555210	-0.629419
WUC46	-0.272394	0.642057	-0.464214
Fuse Vol	-0.518369	0.432488	-0.598179
MTBM Op	0.480697	-0.564104	0.438015
MTBM Sortie	0.570085	-0.581259	0.447518
MH/MA	1.000000	-0.484066	0.494364
SchHr/Op	-0.484066	1.000000	-0.587461
Avg Crew Size	0.494364	-0.587461	1.000000

Cronbachs Alpha = 0.541347 Standardized Cronbachs Alpha = 0.891367

APPENDIX M

Multiple Regression Report

Page	1
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	22:50:54 06-26-1997
Dependent	MTBM Op

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	11.12525	2.223225	5.0041	0.002442	Reject Ho	0.984273
Hyd Sys Cap	5.280196E-02	2.696704E-02	1.9580	0.097964	Accept Ho	0.377803
SQRT Hyd Sys Cap	-1.451915	0.5375625	-2.7009	0.035532	Reject Ho	0.617826
R-Squared	0.742216					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	11.12525	2.223225	5.685216	16.56529	0.0000
Hyd Sys Cap	5.280196E-02	2.696704E-02	-0.013184	0.1187879	1.8865
SQRT Hyd Sys Cap	-1.451915	0.5375625	-2.767283	-0.1365466	-2.6022
T-Critical	2.446912				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	140.3699	140.3699			
Model	2	37.50098	18.75049	8.6376	0.017130	0.516955
Error	6	13.02474	2.170789			
Total(Adjusted)	8	50.52572	6.315715			

Root Mean Square Error	1.47336	R-Squared	0.7422
Mean of Dependent	3.949261	Adj R-Squared	0.6563
Coefficient of Variation	0.3730723	Press Value	32.43658
Sum |Press Residuals|	15.33595	Press R-Squared	0.3580

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	0.8019	0.422590	Accepted
Kurtosis	0.1793	0.857715	Accepted
Omnibus	0.6752	0.713465	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	-0.028535	9	0.064547	17	-0.022627
2	0.207266	10	0.101608	18	
3	-0.136264	11	0.126202	19	
4		12		20	
5	-0.281829	13	-0.049319	21	
6	-0.263939	14	0.059276	22	
7	-0.026797	15		23	
8	-0.173884	16	-0.111443	24	

Above serial correlations significant if their absolute values are greater than 0.666667

Durbin-Watson Value 1.4868

Multiple Regression Report

Page	2
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	22:50:54 06-26-1997
Dependent	MTBM Op

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	7.678948				
2	1.984175	1.180304	1.689919	-2.954778	5.315386
3	3.01673				
4	1.845658	2.354602	1.659027	-1.704892	6.414095
5	1.232851	1.633607	2.015975	-3.299305	6.56652
6	6.932489				
7		1.304754	1.814953	-3.136276	5.745783
8		5.811136	1.61644	1.855848	9.766423
9	1.811901				
10	5.650792	3.261671	1.614797	-0.6895957	7.212938
11					
12	6.24747	5.376558	1.593753	1.476785	9.276331
13	4.725488	5.386432	1.594148	1.485691	9.287172
14	34.366				
15	2.828323	4.383677	1.580321	0.5167705	8.250583
16	14.84923				
17	7.906595				
18	2.357916	3.874894	1.590953	-1.802696E-02	7.767815
19	34.22712				
20	10.30941				
21	8.670675	8.091604	1.913021	3.41061	12.7726
22		5.298737	1.590826	1.406125	9.191349

Multiple Regression Report

Page	3
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	22:50:54 06-26-1997
Dependent	MTBM Op

Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	7.678948				
2	1.984175	1.180304	0.8038708	40.51	2.416116
3	3.01673				
4	1.845658	2.354602	-0.5089432	27.58	2.534184
5	1.232851	1.633607	-0.4007562	32.51	2.353607
6	6.932489				
7		1.304754			
8		5.811136			
9	1.811901				
10	5.650792	3.261671	2.389121	42.28	1.175815
11					
12	6.24747	5.376558	0.8709121	13.94	2.422157
13	4.725488	5.386432	-0.6609437	13.99	2.499596
14	34.366				
15	2.828323	4.383677	-1.555353	54.99	2.035431
16	14.84923				
17	7.906595				
18	2.357916	3.874894	-1.516978	64.34	2.053099
19	34.22712				
20	10.30941				
21	8.670675	8.091604	0.5790709	6.68	2.39146
22		5.298737			

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
Hyd Sys Cap	21.605410	0.953715	0.046285	3.35003E-04
SQRT Hyd Sys Cap	21.605410	0.953715	0.046285	0.1331191

Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	1.976583	98.83	98.83	1.00
2	0.023417	1.17	100.00	84.41

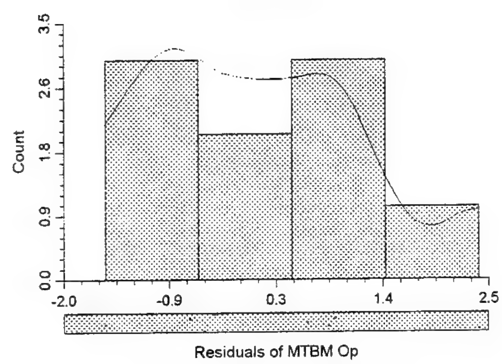
All Condition Numbers less than 100. Multicollinearity is NOT a problem.

Multiple Regression Report

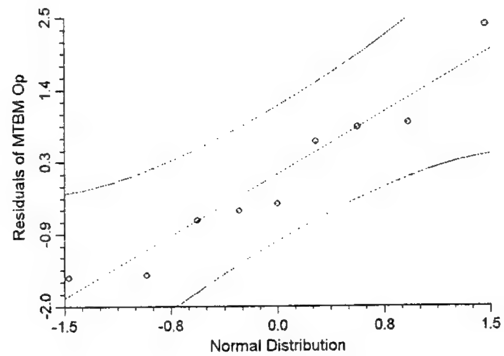
Page	4
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	22:50:54 06-26-1997
Dependent	MTBM Op

Plots Section

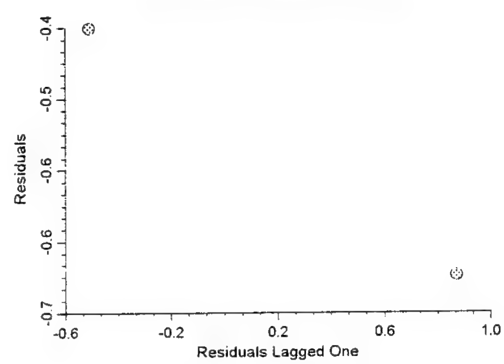
Histogram



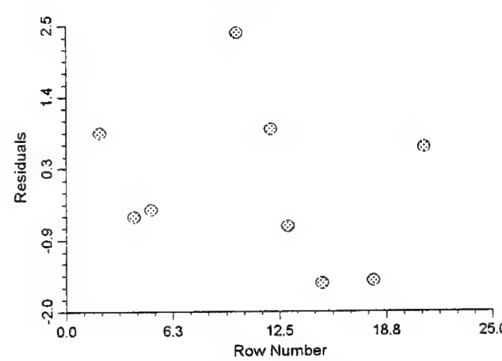
Normal Probability Plot of Residuals of MTBM Op



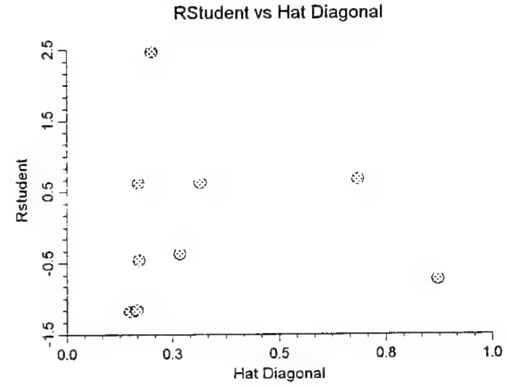
Serial Correlation of Residuals



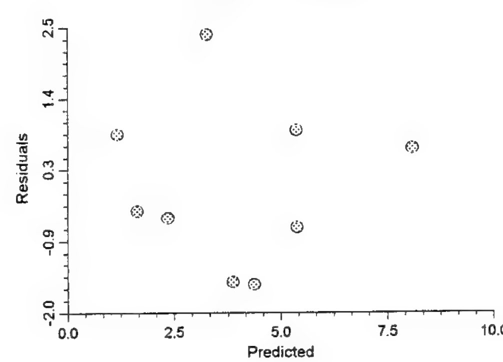
Residual vs Row



RStudent vs Hat Diagonal



Residual vs Predicted



Multiple Regression Report

Page	1
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	19:21:55 07-05-1997
Dependent	MTBM S

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	307.4667	133.4151	2.3046	0.039865	Reject Ho	0.562983
Wgt of Eng	8.800491E-03	3.397793E-03	2.5901	0.023655	Reject Ho	0.662557
SQRT Wgt of Eng	-0.6281232	0.1975809	-3.1791	0.007935	Reject Ho	0.830677
LN WUC 46	3.089895	1.563777	1.9759	0.071613	Accept Ho	0.443477
EXP Wgt of Eng	-311.1282	132.907	-2.3409	0.037321	Reject Ho	0.576044
EXP Num of Eng	83.17032	13.23899	6.2822	0.000041	Reject Ho	0.999917
R-Squared	0.889757					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	307.4667	133.4151	16.78033	598.1531	0.0000
Wgt of Eng	8.800491E-03	3.397793E-03	1.397337E-03	1.620365E-02	14.9418
SQRT Wgt of Eng	-0.6281232	0.1975809	-1.058615	-0.1976314	-5.0878
LN WUC 46	3.089895	1.563777	-0.3172821	6.497072	0.5125
EXP Wgt of Eng	-311.1282	132.907	-600.7076	-21.54879	-10.1251
EXP Num of Eng	83.17032	13.23899	54.32503	112.0156	1.2274
T-Critical	2.178813				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	407.1014	407.1014			
Model	5	552.8043	110.5609	19.3701	0.000023	0.786600
Error	12	68.49384	5.70782			
Total(Adjusted)	17	621.2981	36.54695			

Root Mean Square Error	2.389104	R-Squared	0.8898
Mean of Dependent	4.755707	Adj R-Squared	0.8438
Coefficient of Variation	0.5023658	Press Value	285.0558
Sum |Press Residuals|	50.61303	Press R-Squared	0.5412

Multiple Regression Report

Page	2
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	19:21:55 07-05-1997
Dependent	MTBM S

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	0.7707	0.440878	Accepted
Kurtosis	0.3475	0.728215	Accepted
Omnibus	0.7148	0.699509	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	-0.383765	9	0.072077	17	-0.024800
2	-0.129604	10	0.019045	18	
3	0.130809	11	0.059614	19	
4	-0.173972	12	-0.063389	20	
5	0.188036	13	-0.110611	21	
6	-0.079484	14	0.174259	22	
7	0.091046	15	-0.163702	23	
8	-0.202700	16	0.166244	24	

Above serial correlations significant if their absolute values are greater than 0.471405

Durbin-Watson Value 2.6818

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	4.087939	7.239699	2.623865	1.522788	12.95661
2	0.4508714	0.2956781	2.612195	-5.395805	5.987161
3	0.6935361	-7.236101E-04	2.726434	-5.941113	5.939666
4	0.3017632	0.2549299	2.89833	-6.05999	6.569849
5	0.3057168	-0.8975646	2.985567	-7.402556	5.607427
6	4.860969	6.122281	2.645976	0.3571942	11.88737
7		2.362233	2.722849	-3.570345	8.294811
8		-2.898082	2.900556	-9.217852	3.421688
9	0.5978431	-1.449153	2.792345	-7.533149	4.634844
10	0.7870355	0.3388131	2.629837	-5.391109	6.068736
11					
12	5.171875	5.376904	2.565349	-0.2125122	10.96632
13	3.060681	3.985152	2.632158	-1.749827	9.72013
14	23.17405	21.86674	3.28321	14.71324	29.02024
15	1.239785	3.005243	2.774176	-3.039167	9.049652
16	8.479857	5.325674	2.606715	-0.3538702	11.00522
17	1.73108	4.829092	2.776593	-1.220584	10.87877
18	0.5548038	0.2940554	2.610776	-5.394336	5.982447
19	14.78875	10.39619	2.757392	4.388348	16.40403
20	8.05306	10.2214	2.899386	3.90418	16.53862
21	7.263108	8.398309	2.739097	2.43033	14.36629
22		5.376682	2.582783	-0.2507177	11.00408

Multiple Regression Report

Page	3
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	19:21:56 07-05-1997
Dependent	MTBM S

Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	4.087939	7.239699	-3.15176	77.10	5.089105
2	0.4508714	0.2956781	0.1551933	34.42	6.223991
3	0.6935361	-7.236101E-04	0.6942597	100.10	6.163908
4	0.3017632	0.2549299	4.683329E-02	15.52	6.226336
5	0.3057168	-0.8975646	1.203281	393.59	5.926438
6	4.860969	6.122281	-1.261312	25.95	6.039711
7		2.362233			
8		-2.898082			
9	0.5978431	-1.449153	2.046996	342.40	5.625832
10	0.7870355	0.3388131	0.4482224	56.95	6.203545
11					
12	5.171875	5.376904	-0.2050288	3.96	6.222201
13	3.060681	3.985152	-0.9244704	30.20	6.127887
14	23.17405	21.86674	1.307303	5.64	4.832745
15	1.239785	3.005243	-1.765458	142.40	5.791905
16	8.479857	5.325674	3.154184	37.20	5.109474
17	1.73108	4.829092	-3.098011	178.96	4.882965
18	0.5548038	0.2940554	0.2607484	47.00	6.219043
19	14.78875	10.39619	4.392561	29.70	3.600613
20	8.05306	10.2214	-2.168341	26.93	5.415973
21	7.263108	8.398309	-1.135201	15.63	6.055824
22		5.376682			

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
Wgt of Eng	3622.557790	0.999724	0.000276	2.022663E-06
SQRT Wgt of Eng	278.797187	0.996413	0.003587	6.839423E-03
LN WUC 46	7.324054	0.863464	0.136536	0.4284294
EXP Wgt of Eng	2036.310467	0.999509	0.000491	3094.748
EXP Num of Eng	4.155370	0.759348	0.240652	30.70716

Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	4.269307	85.39	85.39	1.00
2	0.454945	9.10	94.49	9.38
3	0.257318	5.15	99.63	16.59
4	0.018261	0.37	100.00	233.80
5	0.000170	0.00	100.00	25137.95

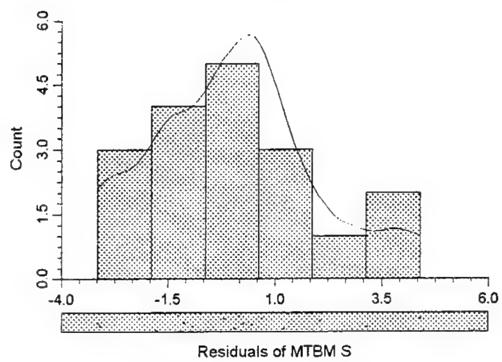
Some Condition Numbers greater than 1000. Multicollinearity is a SEVERE problem.

Multiple Regression Report

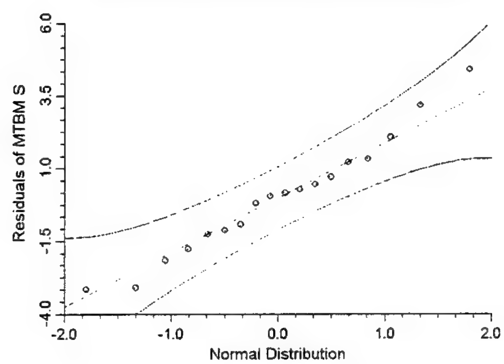
Page	4
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	19:21:56 07-05-1997
Dependent	MTBM S

Plots Section

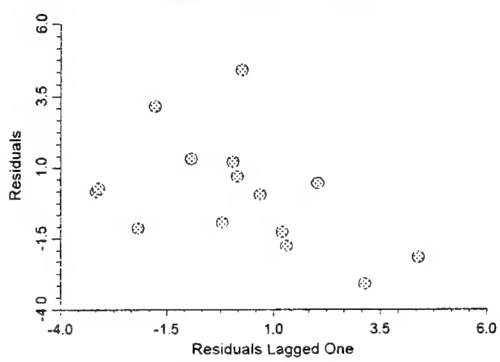
Histogram



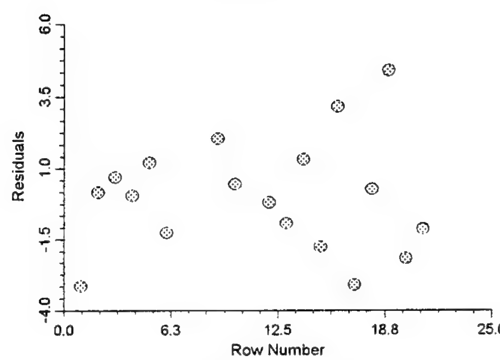
Normal Probability Plot of Residuals of MTBM S



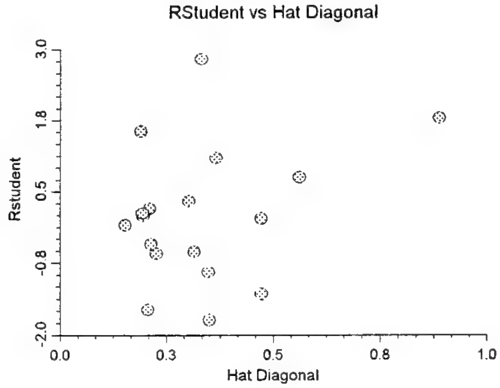
Serial Correlation of Residuals



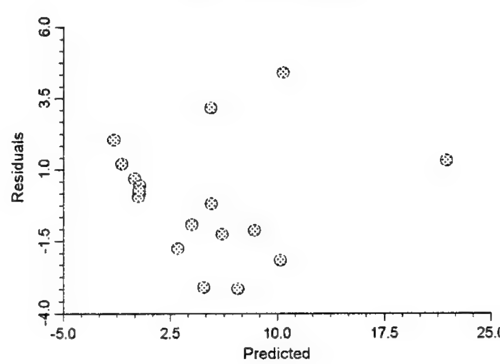
Residual vs Row



RStudent vs Hat Diagonal



Residual vs Predicted



Multiple Regression Report

Page	1
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	23:08:28 07-08-1997
Dependent	MH/MA

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	7.86466	0.6211697	12.6610	0.000224	Reject Ho	1.000000
Hyd Sys Cap	-1.154961E-02	3.837292E-03	-3.0098	0.039557	Reject Ho	0.621938
Avg Len Sortie	-0.3577731	0.1319227	-2.7120	0.053427	Accept Ho	0.538463
EXP Hyd Sys Cap	-350.807	178.3042	-1.9675	0.120519	Accept Ho	0.327241
R-Squared	0.836615					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	7.86466	0.6211697	6.140017	9.589304	0.0000
Hyd Sys Cap	-1.154961E-02	3.837292E-03	-2.220364E-02	-8.955805E-04	-0.6475
Avg Len Sortie	-0.3577731	0.1319227	-0.7240493	8.503168E-03	-0.5964
EXP Hyd Sys Cap	-350.807	178.3042	-845.8589	144.2449	-0.4338
T-Critical	2.776445				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	249.4275	249.4275			
Model	3	14.86193	4.953975	6.8274	0.047237	0.261040
Error	4	2.902425	0.7256063			
Total(Adjusted)	7	17.76435	2.537764			

Root Mean Square Error	0.8518252	R-Squared	0.8366
Mean of Dependent	5.583766	Adj R-Squared	0.7141
Coefficient of Variation	0.1525539	Press Value	1.821642E+14
Sum |Press Residuals|	1.349683E+07	Press R-Squared	-10254481678190.2000

Multiple Regression Report

Page	2
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	23:08:29 07-08-1997
Dependent	MH/MA

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	0.6587	0.510069	Accepted
Kurtosis	1.2455	0.212938	Accepted
Omnibus	1.9853	0.370600	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	-0.436593	9	-0.128554	17	0.000000
2	-0.239063	10	-0.005530	18	
3	0.193027	11	0.041176	19	
4		12		20	
5	0.079831	13	0.003523	21	
6	-0.110231	14	-0.026233	22	
7	-0.014485	15		23	
8	0.143132	16	0.000000	24	

Above serial correlations significant if their absolute values are greater than 0.707107

Durbin-Watson Value 3.3807

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	6.09056				
2	6.06693				
3	6.546312				
4	4.235028	4.540147	0.9862033	1.802008	7.278286
5	3.253332	3.212355	1.201164	-0.1226103	6.547321
6	3.831655				
7					
8		6.644606	0.9410387	4.031864	9.257348
9	3.218694				
10	4.505133	4.295692	1.091299	1.265761	7.325624
11					
12	6.143676	7.169692	0.9814416	4.444773	9.89461
13	8.35793	7.135069	0.9774962	4.421104	9.849034
14	11.63455				
15	6.210086	6.601768	0.9372629	3.99951	9.204028
16	8.009775				
17	4.543479				
18	6.544249	6.294708	0.923336	3.731116	8.858299
19	5.29925				
20	3.889377				
21	5.420691	5.420691	1.204663	2.076011	8.765371
22		5.443141	0.9889324	2.697425	8.188858

Multiple Regression Report

Page	3
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	23:08:29 07-08-1997
Dependent	MH/MA

Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	6.09056				
2	6.06693				
3	6.546312				
4	4.235028	4.540147	-0.3051193	7.20	0.920428
5	3.253332	3.212355	4.097652E-02	1.26	0.9192305
6	3.831655				
7					
8		6.644606			
9	3.218694				
10	4.505133	4.295692	0.2094398	4.65	0.9267127
11					
12	6.143676	7.169692	-1.026016	16.70	0.4457021
13	8.35793	7.135069	1.222861	14.63	0.2378448
14	11.63455				
15	6.210086	6.601768	-0.3916828	6.31	0.9026887
16	8.009775				
17	4.543479				
18	6.544249	6.294708	0.2495411	3.81	0.9423167
19	5.29925				
20	3.889377				
21	5.420691	5.420691	-5.993793E-09	0.00	0.9405093
22		5.443141			

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
Hyd Sys Cap	1.133039	0.117418	0.882582	2.029311E-05
Avg Len Sortie	1.184106	0.155481	0.844519	2.398492E-02
EXP Hyd Sys Cap	1.190292	0.159870	0.840130	43814.94

Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	1.608189	53.61	53.61	1.00
2	0.740153	24.67	78.28	2.17
3	0.651658	21.72	100.00	2.47

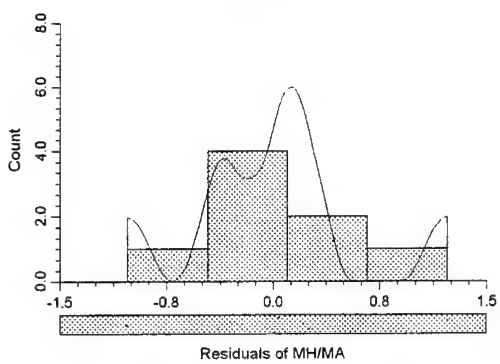
All Condition Numbers less than 100. Multicollinearity is NOT a problem.

Multiple Regression Report

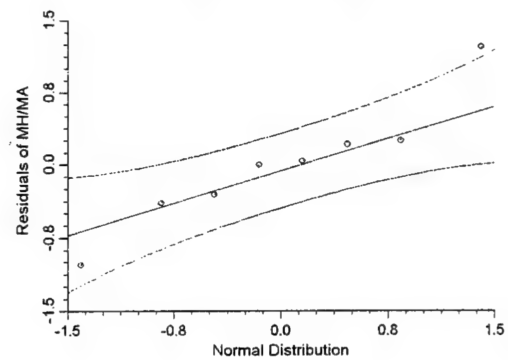
Page 4
Database E:\DATA\NCSS60\ENGINE.S0
Time/Date 23:08:29 07-08-1997
Dependent MH/MA

Plots Section

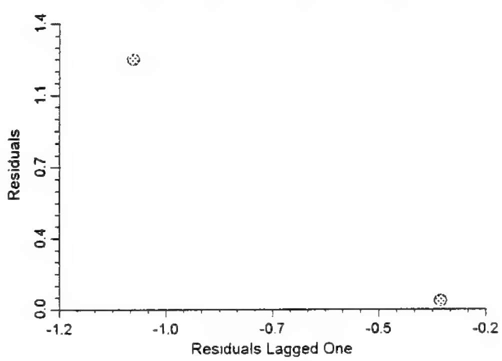
Histogram



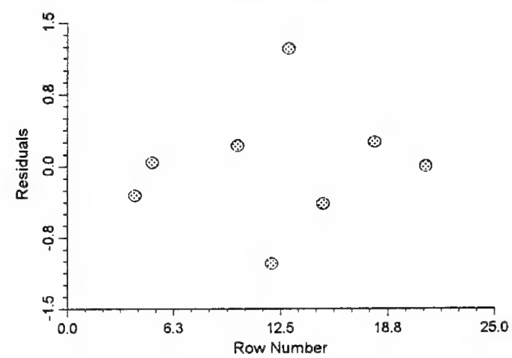
Normal Probability Plot of Residuals of MH/MA



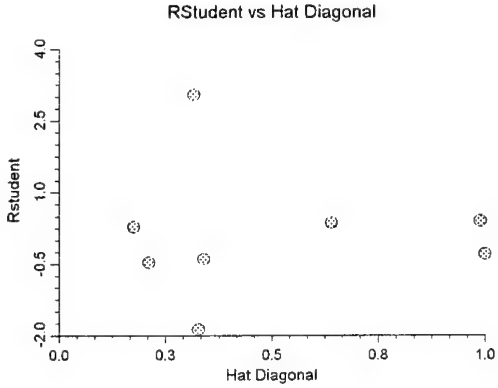
Serial Correlation of Residuals



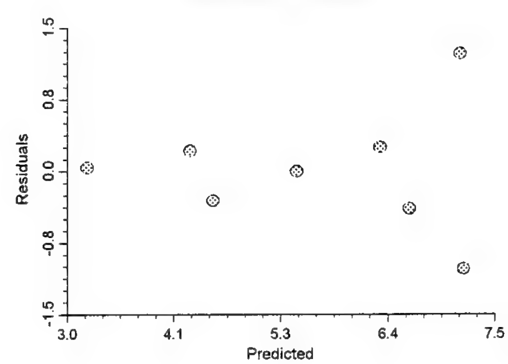
Residual vs Row



RStudent vs Hat Diagonal



Residual vs Predicted



Multiple Regression Report

Page	1
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	22:41:53 07-05-1997
Dependent	SMH/FLYHR

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	-0.3442549	0.1166106	-2.9522	0.025541	Reject Ho	0.693171
SQ Max Power Load	0.0295859	5.545452E-03	5.3352	0.001769	Reject Ho	0.992081
SQ Num of Eng	1.280169E-02	1.742044E-03	7.3487	0.000325	Reject Ho	0.999966
EXP Max Power Lo	1.747529	0.5949652	2.9372	0.026042	Reject Ho	0.688872
R-Squared	0.946947					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	-0.3442549	0.1166106	-0.6295907	-5.891901E-02	0.0000
SQ Max Power Load	0.0295859	5.545452E-03	1.601667E-02	4.315513E-02	0.8484
SQ Num of Eng	1.280169E-02	1.742044E-03	8.539063E-03	1.706432E-02	0.7447
EXP Max Power Lo	1.747529	0.5949652	0.2917012	3.203356	0.4816
T-Critical	2.446912				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	0.9690706	0.9690706			
Model	3	0.8732393	0.2910798	35.6984	0.000320	0.955028
Error	6	4.892314E-02	8.153857E-03			
Total(Adjusted)	9	0.9221624	0.1024625			

Root Mean Square Error	9.029871E-02	R-Squared	0.9469
Mean of Dependent	0.311299	Adj R-Squared	0.9204
Coefficient of Variation	0.2900707	Press Value	9.648289E-02
Sum |Press Residuals|	0.7761633	Press R-Squared	0.8954

Multiple Regression Report

Page	2
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	22:41:53 07-05-1997
Dependent	SMH/FLYHR

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	-0.2712	0.786254	Accepted
Kurtosis	0.5419	0.587854	Accepted
Omnibus	0.3672	0.832250	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	0.009848	9	-0.014752	17	-0.002656
2	-0.117095	10	0.003757	18	
3	-0.010921	11	-0.160511	19	
4	0.110995	12	-0.271581	20	
5	0.189148	13	0.000409	21	
6	0.001403	14	0.070314	22	
7	-0.108535	15	0.007024	23	
8	-0.020298	16	-0.241455	24	

Above serial correlations significant if their absolute values are greater than 0.632456

Durbin-Watson Value 1.9668

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	0.1602664	4.292959E-02	0.1018703	-0.206338	0.2921971
2	0.3518246				
3	0.7075372	0.740569	0.1165099	0.4554795	1.025658
4	0.9044434	0.9045883	0.127517	0.5925654	1.216611
5	0.6697874	0.5784186	0.1034097	0.3253841	0.8314531
6	0.1547023				
7		0.2901071	9.850649E-02	4.907038E-02	0.5311438
8		2.049067	0.3223056	1.260414	2.83772
9	0.6397054				
10	0.1731386				
11					
12	3.838458E-02	0.1053091	0.1001036	-0.1396357	0.3502538
13	0.1735096	0.1790745	0.1093654	-8.853304E-02	0.446682
14	2.181905E-02				
15	0.3746845				
16	4.782271E-02				
17	8.983912E-02	0.22811	9.914621E-02	-1.449206E-02	0.470712
18	0.3908752				
19	3.167931E-02	4.401759E-02	0.101922	-0.2053767	0.2934119
20	0.1502716	0.1465302	0.1010877	-0.1008224	0.3938829
21	0.1872712	0.143443	0.1040644	-0.1111934	0.3980795
22		0.1587229	0.1009216	-8.822335E-02	0.4056692

Multiple Regression Report

Page	3
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	22:41:53 07-05-1997
Dependent	SMH/FLYHR

Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	0.1602664	4.292959E-02	0.1173369	73.21	5.998499E-03
2	0.3518246				
3	0.7075372	0.740569	-3.303184E-02	4.67	9.133608E-03
4	0.9044434	0.9045883	-1.448233E-04	0.02	9.783902E-03
5	0.6697874	0.5784186	0.0913688	13.64	7.359663E-03
6	0.1547023				
7		0.2901071			
8		2.049067			
9	0.6397054				
10	0.1731386				
11					
12	3.838458E-02	0.1053091	-6.692449E-02	174.35	8.622855E-03
13	0.1735096	0.1790745	-5.564858E-03	3.21	9.77301E-03
14	2.181905E-02				
15	0.3746845				
16	4.782271E-02				
17	8.983912E-02	0.22811	-0.1382708	153.91	4.971465E-03
18	0.3908752				
19	3.167931E-02	4.401759E-02	-1.233828E-02	38.95	9.74269E-03
20	0.1502716	0.1465302	3.741319E-03	2.49	9.780879E-03
21	0.1872712	0.143443	4.382816E-02	23.40	9.212817E-03
22		0.1587229			

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
SQ Max Power Load	2.859952	0.650344	0.349656	3.771471E-03
SQ Num of Eng	1.161543	0.139076	0.860924	3.72182E-04
EXP Max Power Lo	3.041041	0.671165	0.328835	43.41302

Eigenvalues of Centered Correlations

No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	2.021731	67.39	67.39	1.00
2	0.789643	26.32	93.71	2.56
3	0.188625	6.29	100.00	10.72

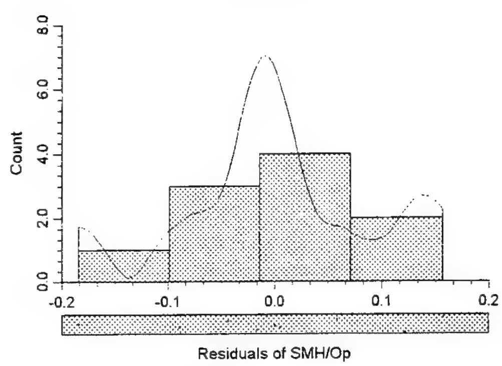
All Condition Numbers less than 100. Multicollinearity is NOT a problem.

Multiple Regression Report

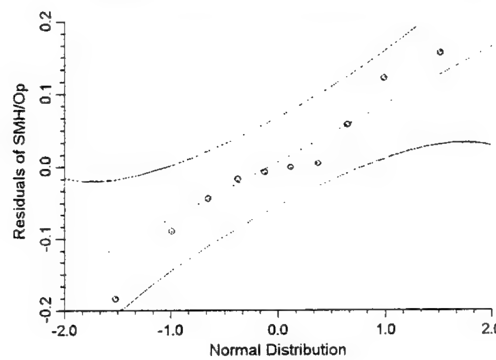
Page	4
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	22:41:54 07-05-1997
Dependent	SMH/FLYHR

Plots Section

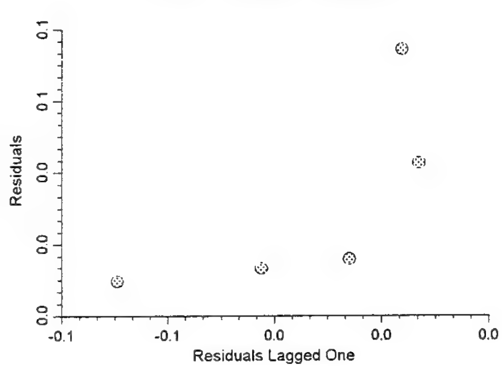
Histogram



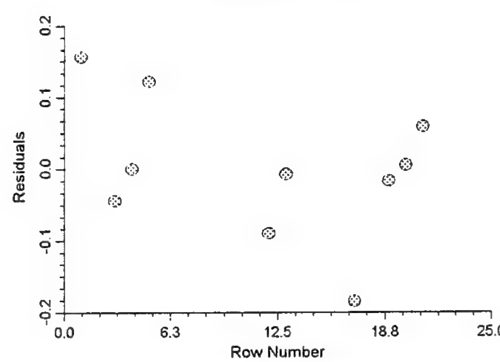
Normal Probability Plot of Residuals of SMH/Op



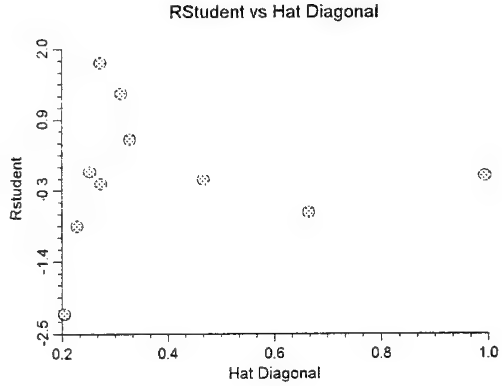
Serial Correlation of Residuals



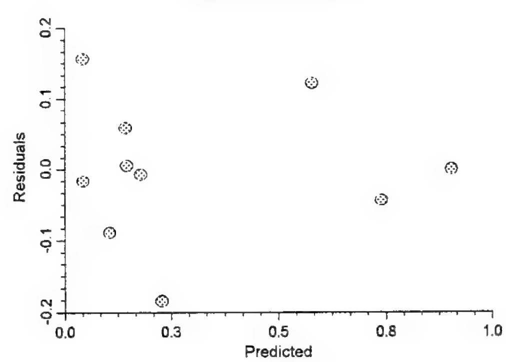
Residual vs Row



RStudent vs Hat Diagonal



Residual vs Predicted



Multiple Regression Report

Page	1
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	00:26:14 07-06-1997
Dependent	Avg Crew

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	5.167743	0.7055595	7.3243	0.000744	Reject Ho	0.999877
LN Max Power Load	-2.390222	0.55948	-4.2722	0.007922	Reject Ho	0.921905
R-Squared	0.784964					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	5.167743	0.7055595	3.354044	6.981441	0.0000
LN Max Power Load	-2.390222	0.55948	-3.828411	-0.952033	-0.8860
T-Critical	2.570582				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	36.32607	36.32607			
Model	1	5.149381	5.149381	18.2519	0.007922	0.921905
Error	5	1.410644	0.2821289			
Total(Adjusted)	6	6.560025	1.093338			

Root Mean Square Error	0.531158	R-Squared	0.7850
Mean of Dependent	2.278034	Adj R-Squared	0.7420
Coefficient of Variation	0.2331651	Press Value	2.265473
Sum |Press Residuals|	3.53118	Press R-Squared	0.6547

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	0.0000		
Kurtosis		1.000000	Accepted
Omnibus			

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	0.045196	9	0.021955	17	
2	-0.304635	10		18	
3	-0.238618	11	-0.088996	19	
4	0.025685	12	0.015626	20	
5	-0.054141	13	-0.145165	21	
6		14	-0.084961	22	
7	0.056147	15	0.164215	23	
8	0.047368	16	0.348854	24	

Above serial correlations significant if their absolute values are greater than 0.755929

Durbin-Watson Value 1.9640

Multiple Regression Report

Page	2
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	00:26:14 07-06-1997
Dependent	Avg Crew

Predicted Values with Confidence Limits of Individuals

Row	Actual	Predicted	Std Error of Predicted	95% LCL of Individual	95% UCL of Individual
1	1.945866	2.741116	0.5780849	1.255101	4.22713
2	2.049639				
3	1.319821	1.123632	0.6288458	-0.4928672	2.740132
4	2.535945	2.112675	0.5691495	0.6496297	3.57572
5	1.333333	1.378893	0.6055801	-0.1777997	2.935587
6	1.833328				
7		2.112675	0.5691495	0.6496297	3.57572
8		2.455314E-02	0.775023	-1.967707	2.016813
9					
10	3.195129				
11					
12	4.015474	3.857611	0.6775948	2.115798	5.599423
13		4.279623	0.7361637	2.387254	6.171992
14	2.998595				
15					
16	2.7525				
17	1.524657	2.008453	0.5713271	0.5398094	3.477096
18					
19	3.271142	2.723858	0.5773411	1.239755	4.207961
20		2.073057	0.5698552	0.6081976	3.537917
21		4.089571	0.7086833	2.267843	5.9113
22		2.027651	0.5708483	0.560239	3.495064

Multiple Regression Report

Page	3
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	00:26:14 07-06-1997
Dependent	Avg Crew

Residual Report

Row	Actual	Predicted	Residual	Percent Error	MSEi
1	1.945866	2.741116	-0.79525	40.87	0.1587849
2	2.049639				
3	1.319821	1.123632	0.1961886	14.86	0.3365793
4	2.535945	2.112675	0.4232698	16.69	0.3000811
5	1.333333	1.378893	-4.556081E-02	3.42	0.3519199
6	1.833328				
7		2.112675			
8		2.455314E-02			
9					
10	3.195129				
11					
12	4.015474	3.857611	0.1578636	3.93	0.3359404
13		4.279623			
14	2.998595				
15					
16	2.7525				
17	1.524657	2.008453	-0.4837953	31.73	0.2832514
18					
19	3.271142	2.723858	0.5472842	16.73	0.2611816
20		2.073057			
21		4.089571			
22		2.027651			

Multicollinearity Section

Independent Variable	Variance Inflation	R-Squared Vs Other X's	Tolerance	Diagonal of X'X Inverse
LN Max Power Load	1.000000	0.000000	1.000000	1.109485

Eigenvalues of Centered Correlations

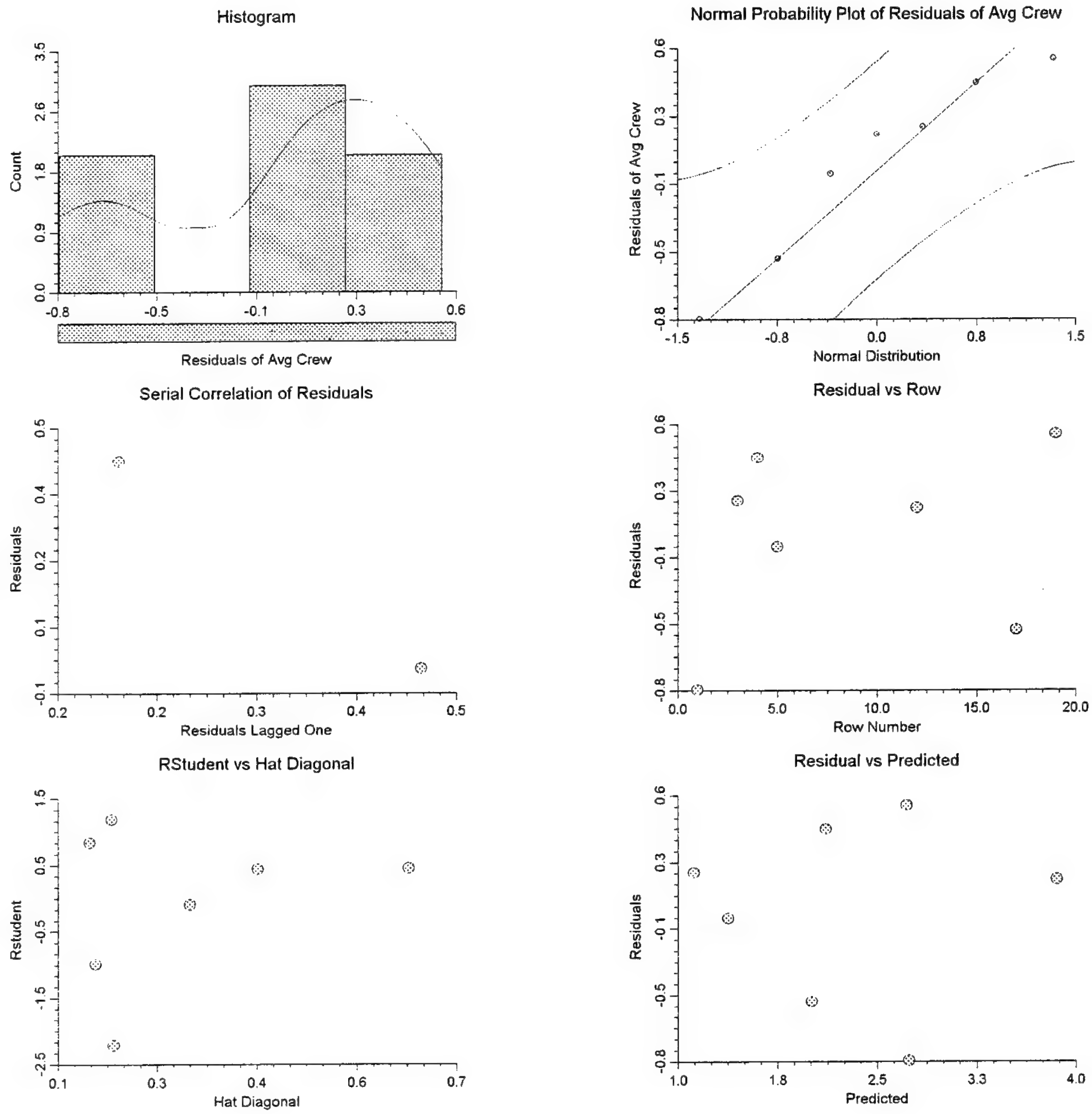
No.	Eigenvalue	Incremental Percent	Cumulative Percent	Condition Number
1	1.000000	100.00	100.00	1.00

All Condition Numbers less than 100. Multicollinearity is NOT a problem.

Multiple Regression Report

Page	4
Database	E:\DATA\NCSS60\ENGINE.S0
Time/Date	00:26:14 07-06-1997
Dependent	Avg Crew

Plots Section



APPENDIX N

Appendix N
Engine Parametric Equations

$$MTBMOp = 11.12525 + .05280196(H1) - 1.451915\sqrt{H1}$$

$$MTBMS = 307.4667 + .008800491(W6) - .6281232\sqrt{W6} + 3.089895(\ln(FS)) - 311.1282e^{W6/66420}$$
$$+83.17032e^{FS/11422.2}$$

$$MH / MA = 7.86466 - .01154961(H1) - .3577731(LS) - 350.807e^{-H1}$$

$$SMH / FLYHR = -.3442549 + .0295859(ML)^2 + .01280169(NE)^2 + 1.747529e^{-ML}$$

$$AVGCREW = 5.167743 - 2.390222(\ln(ML))$$

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